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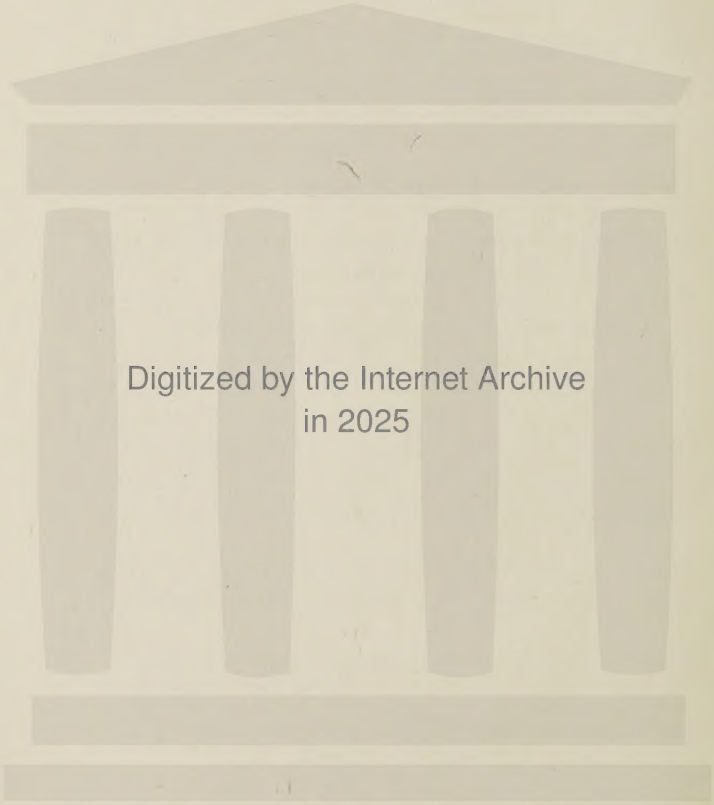
MICHIGAN ACADEMY OF SCIENCE ARTS AND LETTERS

VOLUME XIV

CONTAINING PAPERS SUBMITTED AT THE ANNUAL MEETING IN 1930

(The papers in Botany and Zoölogy of the 1930 meeting appear in Volume XIII.)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PAPERS

OF THE

MICHIGAN ACADEMY OF SCIENCE ARTS AND LETTERS

EDITORS

EUGENE S. McCARTNEY
UNIVERSITY OF MICHIGAN

PETER OKKELBERG
UNIVERSITY OF MICHIGAN

VOLUME XIV

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THE LABORS OF THE *DATOE:* PART II. DIRECTIONS FOR THE CEREMONIES*

HARLEY HARRIS BARTLETT

THE first part of this paper consisted of an annotated list of religious, magical and medical practices of the Batak priest-doctor, the *datoe,* based upon the greater part of a native manuscript written in Asahan, Sumatra, in 1918.

This second part begins with the words *poda-poda i ma gorangoranan hadatoeon batak asahan,* "these are directions (to accompany), the Asahan Batak magic." The numerous bark books which the Batak formerly possessed [1] are for the most part *poda-poda,* "directions." In general they are very obscure, since they were books of individual *datoe,* containing material which the owner did not wish to be generally utilized. If he had a disciple, the book would be copied by the disciple or might descend to him when the old *datoe,* his *goeroe,* died. The bark books (*poestaka*) vary from well-written and apparently translatable manuscripts to those in which many syllables are omitted, or syllabic substitutions and transpositions are made with the object of making a secret and individual book. There were also among the *datoe* some impostors whose books were nonsense.

* Paper from the Department of Botany of the University of Michigan, No. 328 (continued from Vol. 12 [1929]: 1–74).

[1] There are great collections of manuscripts on bark in Leiden (University Library and Ethnographic Museum), Amsterdam (Colonial Institute), and lesser ones in America (Field Museum, Chicago, and the writer's personal collection). There are some in the museums of the East (Raffles Museum, Singapore; Batak Museum, Raja, Karoland) and doubtless isolated manuscripts at many places in Europe as well as in America, since most of the Batak bark books were gathered up a few years ago by peddlers and sold as souvenirs to tourists at Medan and Bĕrastagi. Part of these, it is to be hoped, will drift into the hands of dealers and eventually get into collections where they may ultimately be utilized. There are single examples in the United States National Museum and the private Oriental manuscript collection of Mr. Robert Garrett of Baltimore.

In spite of what some students have thought to the contrary, I am convinced that a study of the Batak books of directions for magic will yield results of value to the ethnologist. The brief *poda-poda* presented herewith are perhaps unique in that they were intended to be intelligible to an outsider. If I have failed to grasp the meaning it is probably because of my imperfect comprehension rather than of any intentional obscurity on the part of the writer (namely, Bidin, in consultation mainly with his uncle, Datoe Silo Tonga).

Text and Translation

poda-poda i ma goran-goranan hadatoeon batak asa-
The instructions (to go with) the list of names of magic of the Asahan

han molo adong panahit disoekkoen tambar[2] toe
Batak. When there is sickness there is requested medicine of the

datoe ro ninna datoe makkisik-kisik dihordjahon
"datoe." Coming, says he, the "datoe," let us bestir ourselves, there

ma diboewat sada toloer boras sa
is a labor to be done. There are to be taken one egg,[3] of rice one

mangkoek lili toenggal pitoe dirahoet ma dohot bonang toloe
cupful, of palm-leaf stalks seven, bound up with thread of three

[2] *Tambar* is a word which is used very broadly. It may be translated as "medicine" if one remembers that an invocation or a ceremony or a magical device as well as a drug may be a medicine. In a restricted sense *tambar* (= *tabar*, *tawar*) is a drug, and generally a plant. *Costus speciosus* (Koen.) Sm. is so generally used as an external remedial agent for rashes, itches, stings, etc., that it is called *tabar-tabar* without qualification. Perhaps the most generally used plants which are grouped as *tambar* are *aloem-aloem* (*Emilia sonchifolia*), *sambak-sambang* (*Urena lobata* L. var.), *si happir* (*Spilanthes acmella* Murr.), *sondoek-sondoek* (*Ophioglossum pedunculosum* Desv.), *soeawa* (*Adenostemma viscosum* (L.) O. Kuntze), *poekor djonggi* (an acanthaceous herb), *pahoe moela djadi* (*Campium heteroclitum* (Presl) Copel.), *si oedoet toelan* (*Galeola sp.*), *si tomoer ringring* (*Chloranthus officinalis* Bl.) and *si margalagala* (*Phyllanthus niruri* L.). The list might be indefinitely expanded, but these plants are the ones that everyone knows because of their medicinal use.

[3] These articles constitute the magical apparatus (*ramoewan*). The egg may be used in divination, to find out the nature of the evil or from what direction evil has come. The rice is thrown over the participants in a ceremony in order to purify them and the place where the ceremony is performed. The seven stalks, three colors of thread and one ring make a number combination of mystical and magical significance.

roepa [4] dohot tintin sada apoeran pinarsaloeksoeng [5] sada
colors, with one ring, of the things needful for "sirih" chewing,

apoeran opat kababa digalangkon ma di
one leaf cone. Of "sirih," four mouthfuls are to be offered at the

dalan dipijo ma tondi ni naboritan i noengon i
path. To be invited is the soul of the sick person. This having been

didjoppoet ma boras sikko-sikko
done, there is to be taken with thumb and two fingers rice, an even

i janggo hoehoep na ong sihko
number (of grains). If it is the right amount it will be an even number.

ma anggo gandjil na ongso sihko ma i dipadoewa hali moese
If it is uneven, not divisible by two, it is to be taken a second time, and

noeng hoehoep baroe na ong sikko ditippoes
again, until correct. The new quantity being indeed even, it is to be

ma boras sikkosikko i diboan mamoelak toe djaboe
wrapped up, the rice of even number. This accomplished, return to the

dibolgangna toloer i noeng didjoppoet-
house. To be boiled by him without salt is the egg. That done, there is

ton harboewe i toe oeloe ni nabori-
to be held between thumb and two fingers the rice at the head of the sick

tan i noeng mamasak toloer i dileon ma toe datoe i
person. By this time cooked, the egg is to be given to the "datoe."

[4] The *bonang toloe roepa*, "thread of three colors," which is so frequently called for in Batak ceremonial and magic is considered of no value unless it is the kind formerly used for weaving their own cloths. With the discontinuance of spinning and weaving since European goods became abundant, the few hanks of old thread that remain are highly valued heirlooms, *poesaka*, and fine old cloths have not infrequently been unraveled to get thread for ceremonies. The colors are black (for which indigo may be substituted), red and white, these being the propitious or sacred combination. Yellow is rarely substituted for red.

[5] The *pinarsaloeksoeng* is a conical receptacle made of leaves (resembling a cornucopia) containing all the constituents for *sirih* chewing. It contains a conventional amount which, according to experience, will be needed in various multiples for festivities or ceremonies of various sizes. A guest often brings a *pinarsaloeksoeng* as a gift, as his share of the provision for a party to which everyone who is invited contributes his bit, although of course the bulk of the necessities is provided by the person in whose interest the ceremony is carried out (the *soehoet*) or by his relatives (*hasoehoetan*) in his behalf.

diporida datoe ma toloer i disi ma haidahan pangi-
To be examined by the "datoe" is this egg. There is the vision which is

dahan na naeng disakkoet hoela-hoela
revealed to him; whether it is desirable to propitiate the wife's family

dohot hijo marhandang [6] naeng disakkoet dohot mas na hona
with a bordered cloth, desirable to propitiate with gold one whose

pidjor naeng dihasakkoetan dohot hijo marsi-
desert is solder, desirable to make propitiation with a cloth of uncut

togoetogoean [7] naeng oepaon naeng martoboes
fringe, desirable to give gifts, desirable to offer ransom,

[6] The *hijo marhandang* was à cloth with a magical border design. Such a cloth was a *pagar*, "protector." Just as the word *pagar* has the meaning of an actual fence, as well as a spiritual or magical protector, so does the word *handang* also. It may mean a bamboo hedge or a stockade. A child laid on or carried in a *hijo marhandang* was protected by the magical border, as it would be if kept within a strong fence.

[7] The *hijo marsitogoetogoean* is a cloth woven with the warp passing continuously around the loom, and several inches of the woof left out, so that by cutting across the middle of this uncompleted gap a fringe would be left at each end of the cloth. To have the magical properties of the *hijo marsitogoetogoean*, however, the fringe threads must be left uncut when the cloth is taken off the loom. To such a cloth are attributed the virtues of a protector (*pagar*), especially after it has been used in various emergencies with supposedly beneficial results. The older it is, the better. The writer secured a *hijo marsitogoetogoean* at Silo Maradja which was reputed to be very old and to be very efficacious at childbirth (Pl. VI, Fig. 2). The child was laid on the filthy cloth. The continuity of the warp across the gap where the woof had not been woven in was said to be magic to insure the continuity of life from the mother to the child, and "the going on of the generations." The birth of a child was represented by the beginning of the woof at one side of the uncut fringe. As one drew the cloth through the hands it represented the growing up of the child, and when the other side of the uncut fringe was reached, it represented the beginning of a new generation whose life would repeat that of the mother, and so on indefinitely. When I secured the cloth it was so foul that no design could be seen in it, for it had been left unwashed in order to preserve "the soul of the uncleanliness." After being disinfected and washed, it proved to be striped with white and indigo, in the center. Down the edges it has a red, white and indigo *handang*, or border, the sacred color combination indicating that it may have been woven in the first place with intent that it should be a *pagar*. It is too small to have had any utility as clothing except for a small child. If such a *pagar* had been made and no success attended its use, it would have been concluded that some error prevented it from acquiring a powerful soul, and it would merely have been used up for ordinary purposes.

naeng markirap naeng marsahata naeng
desirable to recall a soul, desirable to have a reconciliation, desirable

mambere ompoe naeng mambere pagar
to sacrifice to the grandparents, desirable to sacrifice to the protectors,

naeng mambere pangoeloebalang
desirable to sacrifice to the (captive spirit) leader of the warriors,

naeng mambere simangot ni na haenggalan
desirable to sacrifice to the spirit of the burial place of the new-born,

mambere padjoean [8] naeng mambere begoe ni hoela-hoela
to sacrifice to the ancestors, desirable to sacrifice to the ghosts of the line

naeng mambere sinoemba naeng
of the female ancestors, desirable to sacrifice to the wild spirit, desirable

mambere sinoemba ni ladang naeng mambere sir
to sacrifice to the wild spirit of the forest clearing, desirable to sacrifice

naeng palao si paembar naeng
to virility, desirable to go about substitution by a clay image, desirable

palao parsili naeng palao holong ni
to go about substitution by a banana image, desirable to go about (se-

[8] Throughout Part I *padjoe-padjoean* is translated "ancestral spirits." In Neumann's fine article (8) on the places of offering among the Karo Batak will be found a discussion of the cognate Karo word *padjoeh-padjoehen*, which he relates to *ipadjoeh*, "to offer food." "From this also the general name *padjoeh-padjoehen* 'place where or something to which one commonly gives to eat.' This is also a general name for offering-place" (8, p. 515). Although among the Pardembanan group *padjoeh-padjoean* means ancestral spirits, i.e. "those to whom offerings of food are made," rather than the place of offering, we find in the word *sombaon* (see Part I, pp. 18–19) a parallel for two corresponding diverse meanings, namely, a sacred or haunted place (this meaning prevails in Pardembanan) and the spirit living in such a place (the prevailing meaning in Toba). I was especially interested to know definitely whether or not the term *padjoe-padjoean* referred to the ancestral spirits on the male side, in contrast to those of the *hoela-hoela*, to whom sacrifices are also made, and found that it was an inclusive term. For instance, in my adoption ceremony there were invoked "four nations of ancestral spirits" (*padjoe-padjoean opat bangsa*), which were called in order as follows: (1) those of Silo Monggor, (2) those of Toewan na Poso (the familiar name of the chief, Ria Maradja *marga* Si Rait Holboeng), (3) those of Datoe Boersok *marga* Si Toroes (this "nation" of ancestral spirits is that of the chief's *hoela-hoela*, since the chief's wife and mother were *marga* Si Toroes), and (4) those of Poeloe Mariah. The significance of two of the "nations" (first and last) I did not grasp at the time, and failed to inquire later, but it will doubtless be explained by the chief's *tarombo* (genealogical record), when that is delved into.

roha naeng manabari i ma na tardjoep-
curing) love of the heart, or desirable to purify — whatever situation is

pang dipangidahan ima idokkon datoe dihor-
encountered, it is revealed. It is declared by the "datoe." If the labor

djahon soehoet ma i oelpoehan ni
is caused to be undertaken by the one concerned, the soothsaying

datoe i baroe olo oemmiran naboritan i
of the "datoe" is immediately favorable to the life prospect of the

i ma goran-goranan ni pangidahan dihadatoeon ni batak
invalid. Such is the naming of the visions to be had by magic of the

asahan ja mambere sinoemba ni ladang
Asahan Batak. If sacrificing to the wild spirit of the forest clearing

mambaen andjapan ma ija parsili manggambar
make an altar; if (there is to be) a substitute carve into an

batang ni pisang ma i dohot diondasi
image a trunk of banana; (accompany the carving) with ceremonial

janggo mambere simangot manggalang-
drumming. If making offerings to the deified souls, prepare a sacri-

galangi ma i dipijo ma soede dohot saoedara boroe
ficial feast. To be invited are all, including the female relatives

hoela-hoela [9] pariban
of the female side, the wife's sisters and the daughters of the mother's

[9] Although the Batak are set off from the Menangkabau of south Sumatra by their patriarchal rather than matriarchal organization, it is nevertheless true that the position of woman (among the Pardembanan, at least) is very important. Certainly in Pardembanan ceremonies the female ancestry receives quite as much attention as the male. No ceremony is more attended to than the one called *mangoepa hoela-hoela*, the giving of gifts to the women of the *hoela-hoela*, on some of the same occasions at which the spirits of the *hoela-hoela* ancestors receive offerings of food. At my adoption by *marga* Si Rait Holboeng (see Part I, pp. 30–32) in which ceremony I was, of course, chief participant (*soehoet*), the whole group of participants of my own *marga* were termed the *hasoehoetan*. The latter (especially the women) contributed heirlooms, coins and *sirih* to the *hoela-hoela* women at the outset of a feast to which the *marga* Si Boeea was also invited. The actual bringing of the gifts into the purified inclosure (*parhordjaan*), accompanied by sword-dancing and music, has already been described for a similar occasion (see Part I, Pls. XXV–XXVI), but the presentation of the gifts has not been. When the procession of gift-bearers entered the chief's house the group for the presentation ceremony was arranged by the *datoe* on a large sitting mat, in two rows facing each other. On one side in the center sat the chief, Ria Maradja, with myself at his right, and at my right Toewan Silo Bolon, the chief of a district belonging of old to

manggoeal toba ma i padjongdjong ma
brothers. Make the music of Toba; let things be got in order; let the
datoe mandjaga i parhordjaan marsakkak-sakkak ma i
"datoe" guard the place of ceremonies; make the bamboo baskets for

Silo Maradja, and therefore ceremonially a vassal as well as *marga* brother of Ria Maradja. All these persons, including myself, belong to *marga* Si Rait Holboeng. At Ria Maradja's left sat his wife, Sarmain, and his sister-in-law, Lidjah, both of *marga* Si Toroes. Exactly opposite the chief, facing him, with the burning censer between, sat Datoe Boersok. At his left were Mat Rohim, Indoh Matoelang and Si Gedding, all men of Si Toroes, the two former being close neighbors of Ria Maradja and friendly to myself, and the latter, an old man, a younger brother of Datoe Boersok's father. At the right of the *datoe* were women of *marga* Si Rait Holboeng, namely, Sainim, wife of Mat Rohim, Minim, wife of Indoh Matoelang, and a very old woman who had come with the guests from Silo Bolon. The reader will note that the arrangement was such that women sat opposite women and men opposite men; men sat beside the group of women who either were or might have been their wives, from their own actual or *marga* sisters. This is the most auspicious seating for a ceremony. The valuable "gifts" were unwrapped, fumigated by the *datoe*, passed to the women of Si Toroes, who sat opposite, and by them passed to the other *hoela-hoela* women in the house, who returned them to their actual owners, for in such a ceremony only the coins and *sirih* are kept. Then the men of Si Rait Holboeng offered *sirih* to the men of Si Toroes, using a betel set which was an heirloom of *marga* Si Rait Holboeng, and which had been presented to me (as a permanent gift) by the *hasoehoetan* in order that in this and future ceremonies I might be recognized as of *marga* Si Rait Holboeng by the spirits of the ancestors. Then followed the feast, in which the principal participants had to start eating in a fixed order before the other guests were served. I took the first mouthful, followed in order by the chief's wife, his sister-in-law, the *datoe*, the remaining *hoela-hoela* men who sat on the mat, the *radja*, Toewan Silo Bolon, the *radja*'s brother (Dji Maradja, who presided at the cooking and had therefore not sat on the mat), and finally the women of *marga* Si Rait Holboeng who sat on the mat. Then the other guests were served. Practically all of them except the two *marga* mainly concerned belonged to *marga* Si Boeea, the only sept whose dead, according to the stories, do not return inland to the mountains, but descend the rivers and become crocodiles. This *marga* (at Silo Maradja) is looked upon as particularly closely affiliated with Si Rait Holboeng and also prefers to marry into Si Toroes. At the conclusion of the feast the *namora* men (those "of importance" who sat on the mat) of Si Rait Holboeng had rice grains of three colors placed on their heads by the *hoela-hoela* women.

Among the gifts brought to the *hoela-hoela* by the *hasoehoetan* were ivory ear plugs (*sobang*), silver bracelets (*sago maroka*), hair-pins (*soesoek sanggoel*), old-fashioned hollow gold beads shaped like a mangosteen fruit (*mordjan tampoek manggis*), red coral beads (*si mata*), ornaments made of gold and silver coins (*paoen*) and long, hollow silver or gold beads (*mordjan goela bandjar*). (The beads last mentioned are named from their resemblance in shape to the little packages, each containing two cones, of native sugar. See 3, Pl. VI b).

inganan ni ari i dohot
the sacred herbs, the (weather magic) receptacles of the day; assisted

begoe monggop ase oenang adong
by the hidden household spirits (let him make offerings) that there may

halak na sorpoon sadoha parhor-
not be persons who terrify by demon possession. To bless the cere-

djaan i disi manambol babi ma i molo soedara siabangan
monial place, there cut up a pig. When one is a relative of the

pipi ni babi i ma disi molo
elder-brother class, the cheeks of the pig (are given him) there. If (one

soedara sianggijan imboel-imboel ni babi
is) a relative of the younger-brother class, such parts as the tail of the pig

i ma disi janggo boroe borgok ni babi i ma disi
(are given him) there; if a woman the neck of the pig (is given) there;

janggo sahoela-hoela toelan bolon ma disi janggo ja
if one of the wife's kin, the great bone (is given) there; if, however,

radja ni hoeta i sakkae bagijan ni i i ma
one is the chief of the village a right-quarter cut of the pig (is given him).

paratoeran ni halak na marsaoedara di parhordjaan
the precedence of the people who claim relationship at the place of

abis ma i djolo pasal toe parhordjaan
ceremony being settled, the next thing (is to go) to the ceremonial inclo-

pasal hata ni goewal adong sendoer-sendoer
sure for the matter of speech about the music. There is the tune of the

adong palija-palija adong rap male-
droning; there is the tune of the "pod tree"; there is "crackle of the

dong adong torbang lisak adong si opat ringgit
breaking"; there is "flying-swishing"; there is (the tune of) "the four

adong tappoel siala adong beta-beta
dollars"; there is "chopping wild ginger"; there is "starting after rest";

adong haro-haro [10] adong doding sibaro
there is (the tune of) "the 'Haro-haro'"; there is the "song of the sufferer

[10] Haro-haro is the name in the southern Batak districts of a *marga* of the Karo Batak to the north of Lake Toba, called by themselves *marga* Karo-karo. In the traditional account of the origin of the present ruling family of Asahan there is a story that there was an invasion of Asahan from Atjeh about 1620. The Atjehnese found among the people no one with whom they could talk except a certain Karo Batak named Bajak Lengga, who spoke Malay.

adong haro-haro daboroe adong
from ulcers"; there is the (tune of the) "'Haro-haro' women"; there is

haro-haro pandjang adong rap maledoeng
(the tune of) "the tall 'Haro-haro'"; there is "crash of the yielding."

i ma pahara ni goewal sagala goran-
So much for the consultation about the music: a complete naming

gorananna ija mambaon djoewal [11] dibaen
of it. If one has brought a large measure of rice, the cooked

indahan dibagas djakki [12] i di toengoep i dohot
food is to be put in the house. The gift basket of cooked food is to be

hijo tijan atas dihoetti daboroe
covered with a bright cloth on top and carried on the head by a woman.

ma i ima atoeranna pasal
Such a one has her proper place (in the procession). So much for the

parhordjaan na denggan janggo pasal pa-
matters pertaining to a fine place of ceremony. If it is a matter of

ratoeran na mate halak marsaoedara ma-
orderly arrangements for the dead, the persons who observe ties of

noekkir janggo radja na mate i
relationship give presents to the family. If it is a chief who is dead,

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Bajak is the Karo word for "chief," and is not used in the southern Batak dialects, so that the intrinsic evidence as far as it goes would show that there actually was contact between the Karo people and Asahan at that time. Bajak Lengga became the ancestor of the present ruling sultans of Asahan, and his influence on the Asahan culture, even if he was only a straggler from so distant a district as Karoland, may have been very great. There is now no *marga* Haro-haro in Asahan, but some of the tunes belong by tradition to that *marga*.

[11] The *djoewal* is a definite measure of cooked rice. In making the estimates of the provision needed for a party of a certain number of guests it is assumed that some of the guests will bring enough staple supplies for themselves in the form of *djoewal*.

[12] The *djakki* is a more elaborate contribution to a festivity than the *djoewal*. It consists of rice cooked with chicken. In the elaborate covering some money is also done up, if possible, as a token of good will and as a contribution to the prolongation of the celebration. The cloth with which the *djakki* is covered when it is brought to the party on the head of a woman is also a traditional part of the gift. A woman who has brought a *djakki* to a party is received with every mark of distinction and is given a place among the honored guests.

mamboan hoeda-hoeda pedan na radja sijap
one brings a horse-mask, who was a bosom friend of the deceased chief

mamparmoensak dohot topeng maralo ma di si-
and acts in a dance with dancers in human masks. There is fighting

lang [13] i dohot topeng i na di
at the cross-barrier (as each masker arrives) with the human masker

bagasan i hijan dohot hoeda-hoeda i na di bagasan
who was in the house earlier, with the horse-masker who was in the house

i hijan dohot parmoensak na di bagasan i hijan [14] ja
earlier, with the dancers who were in the house earlier. When

lao manom mambaen tardas [15]
they go down into the house area they prepare hand-railings for the

mambaen djilitan [16] mambaen balijang mambaen
house-ladder; they make a coffin; they prepare cooked dog; they make

[13] The crossed sticks in the form of an ×, called *silang*, over which all who enter a ceremonial inclosure must step, are shown in Part I, Plate XXVI. They constitute one of a pair of protective devices which are believed to exclude evil spirits. The other is the arch (*pintoe godoeng*) hung with young yellow sugar-palm leaflets (*gaba-gaba*), under which the *silang* is placed after evil spirits have been expelled from the ceremonial inclosure. (See Part I, Pls. IV and XXVI.)

[14] Compare this whole account with the observations of Van Gelder, quoted by Fischer and summarized in an earlier article by the writer (4, p. 11). The agreement is excellent, for of course the "fighting" at the *silang* as each new *topeng* arrives is mimic. The writer has seen the *topeng-hoeda-hoeda* dance only at the burial of a *parsili*, as explained in Part I, p. 36. On that occasion there was but one *topeng* to dance with the *hoeda-hoeda*, and one sword dancer without a mask. (See Pls. I–III.) The *topeng* and *koeda-koeda* of Karoland are shown in Plates IV and V.

[15] *Tardas*, hand-railings for the house-ladder, are a perquisite of royalty (*kabosaran; karadjaan*) and may not be used at the funeral of a common man. They are perhaps reminiscent of an ancient time when the *radja*, an alien, lived in a house with steps and railings, different from that of his subjects. The royal bier (*roto karadjaan*), upon which the *radja*'s coffin is carried to the grave, has the Sanskrit name for a cart or chariot, suggesting that some type of wheeled vehicle inappropriate to the jungle and now unknown may have existed at that remote time when the chief's "palace" (*astana* — also Sanskrit) had railed steps. (See Pl. II.)

[16] *Djilitan* is equivalent to Toba *geritan* and Karo *gĕritĕn*. In Asahan it is a coffin. In some parts of the Toba region it was a receptacle of stone, shaped like a sarcophagus, in which were kept the skulls of the ancestors. In Karoland it is a much-ornamented and neatly constructed little building in which the

hadjang palis [17] dioendar-oendarhon pitoe hali
the grave shelter, rain defying. They cause (the body) to be carried

lao-lao das ma toe tanoman i ditahan
back and forth seven times, going to and fro from the grave. There is

parmoensak ma ibereon ni soehoet [18] i ma i
uninterrupted dancing by sons of sisters of the important person.

ringgit onom bolas ase baroe dileon talipar toe tanoman
Sixteen dollars, an offering in advance, is given for quick and satis-

i noeng ditanom
factory termination at the grave. This done, the body is buried;

dihalang ma dibaen ma gana-gana dohot anisan [19]
the grave is framed up; there is made a carved image together with a

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ancestral bones are kept, after they have been cleaned by burial and dug up again. (See a very interesting article by Tassilo Adam, 1.)

[17] The *hadjang palis* is a temporary canopy placed over a fresh grave. It consists of a slanting tentlike roof and hanging fringe, the latter cut from folded cloth or paper into an intricate design. (See Pls. II, III and VI.)

[18] At a funeral the *soehoet* (person in whose behalf a ceremony is held) would appear to be the deceased himself, since the dancers are mature men, and the word *ibereon* generally designates the class of nephews who are the sons of one's sisters. It is often necessary to defer the funerals of chiefs for many years before the ceremonies can be carried out properly. According to Batak conceptions there will be no lack of *ibereon* even if the deceased has no actual sisters, for women of his own *marga* of his own age class stand in the relation of sister to him. If his heir is very young, and the nephews also, the ceremonies will be deferred, and the corpse will be kept in a coffin in the house. (See 4, p. 55, and Pl. XV.)

[19] The carved image (*gana-gana*) of the *radja* and the grave-post (*anisan*) have been described and illustrated elsewhere (4). On my last visit to Asahan (1927) I made further inquiries about the grave-post in order to see whether there might not be some remaining evidence of its origin in the vocabulary pertaining to it. Almost all the old grave-posts had disappeared, but the elderly men who were with me at Silo Maradja when I photographed the one shown in Plate VII named the carvings on it in order from the top downward as follows:

taboe (water-bottle)
ipon-ipon (teeth)
mangkoek-mangkoek (a sort of cup)
horoek-koroeng (a necklace)
boewa karnas (fruit of pineapple)
horoek-koroeng (a necklace)
boewa galoegoer (fruit of *Garcinia*)
horoek-koroeng (necklace)
ipon-ipon (teeth)
horoek-koroeng (necklace)
ipon-ipon (teeth)
horoek-koroeng (necklace)
ipon-ipon (teeth)
horoek-koroeng (necklace)
ipon-ipon (teeth)
horoek-koroeng (necklace)
solotan napoeran (*sirih* container)
daoen limo (citrus leaves)
pinggang (plate)
tadjik harnas (pineapple sprouts)
roembi (cylindrical wooden strong-box)

angka partoenggoel [20] djerat dibaen sada
grave-post; and the several pillars for the grave-house. There is pro-

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Datoe Maasen (*alias* Djaedim) of Silo Maradja later carved replicas of male and female grave-posts, which are now in the Raffles Museum at Singapore. (It was impossible to secure old ones for the collection.) These less elaborate posts such as would be made for younger people, were carved as follows from above downward:

ANISAN BAOEWA (♂)	ANISAN DABOROE (♀)
taboe (water-bottle)	*sopo-sopo basiha* (house on posts with granary above)
mangkoek (cup)	*mangkoek-mangkoek* (a sort of cup)
boewa galoegoer (fruit of *Garcinia*)	*solotan napoeran* (*sirih* container)
solotan napoeran (*sirih* container)	*boeloeng limo* (citrus leaves)
boeloeng limo (citrus leaves)	*pinggang* (plate)
pinggang (plate)	*takjik harnas* (pineapple sprouts)
tadjik harnas (pineapple sprouts)	*roembi* (round strong-box)
roembi (round strong-box)	

It is obvious that the Batak retain no memory of the lotus symbolism of the Hindus, which I have attempted to trace in the carvings of the *anisan*. This fact seemed to have been established when I made the older notes (in 1918), but in the intervening years I had come to wonder whether I had really secured all the information that was to be obtained. The new information agrees in the main with the old and amplifies it considerably: thus, the disks separating the other carvings have a name, *horoek-horoeng*, meaning "necklaces," and certain other carvings not named before are the pineapple, the pineapple sprouts, the plate and the strong-box. The latter (*roembi*) is the cylindrical base of the post, which is buried in the ground. Some of this information might have been given in the former article (4), but the data then seemed so vague as hardly to be sufficiently authentic. The only possible disagreement is in the name for the uppermost carving of a common woman's post, then called "perhaps a cooking pot" and now "a kind of cup." Since there will probably never be any future additional record of the pagan *anisan*, unless in the unlikely event of a professional ethnologist working very soon in Asahan, it seems advisable to include among the illustrations for this article a typical burial place encountered during the last visit. It might hardly be worth while to do so if the grave-posts were collectable and were represented in our museums, but they are not, and cannot be, unless someone wishes to steal them! (See Pl. VIII.)

[20] The stakes which are driven into the ground to support the boards (*bata*) which frame the grave mound (*tanoman*), or to support the frame of the hearth (*dapoer*) on top of the mound, or the upright pillars for the grave-house (*djerat*), are called *partoenggoel*. They are generally carved, although not so elaborately as the grave-post (*anisan*). The use of *partoenggoel* at the corners of the boxlike frames is well shown in the illustrations of a former paper (4, Pls. I; III, Fig. 2; IV, Fig. 2).

pinggan [21] dohot taboe tano songon i ma pa-
vided one large plate with a water jar of clay. In this way one makes

ratoeran ni radja-radja momate molo palao pangoelak
the arrangements for royalty at death. When they set about returning

panabari dipadjongdjong ma sakkak-sakkak di alaman
to the house for purification there are set up containers for sacred herbs

dibaen ma mombang dohot
and offering at the house-yard. There is made the hanging charm with

mare-mare ditijop ma sada toembak
fringes of young yellow sugar-palm leaves. There is to be whetting of

dohot halasan martoedoeng-toedoeng hijo
one spear with a fighting knife. He has his head covered with white

poeting ma datoe i diboersik ma gambaran ni
cloth, has the "datoe." Sprayed with spittle are the pictures on

[21] The *pinggan* (plate) on a chief's grave was sometimes a home-made clay one, but was more often a piece of crude Chinese export ware. Some few really very beautiful pieces of Chinese porcelain reached the Batak by trade long prior to the time of their intercourse with Europeans. We know from Anderson's account (2) that as late as 1823 the cannibal lowland Batak of the East Coast (Pardembanan and Simeloengoen groups) had had no European contacts and possessed practically no European goods. For several centuries, however, Batoe Bara had carried on a brisk trade with other branches of the widely dispersed Malay people, exchanging, among other commodities, Batak slaves for foreign goods. The slaves were presumably secured less often by direct raids than by trade from neighboring Simeloengoen and Pardembanan chiefs who had raided their neighbors. Thus through the intermediacy of the Malays the Batak secured the porcelain which they prized so highly. They seem to have had more big plates than smaller china ware, and therefore often put a porcelain plate on the grave with a home-made water-bottle (*taboe tano*). The latter was pottery of a quite extraordinary type, artistically of great merit, but technically of poor quality, since it was made of poor clay and was imperfectly burned. (See illustrations in a former article 4, Pl. VII, Fig. 2.) The Pardembanan group, it would seem, no longer make any pottery, but supply their needs by trade, securing rough ware (cooking pots) from Toba and cooking pots and ceremonial objects from Batoe Bara (see Appendix II) and finer articles of foreign origin at the towns. Pottery for ceremonial purposes, especially the *taboe tano* for the graves of chiefs, was the last kind of which home manufacture was discontinued. In recent years old Chinese porcelain has been rather thoroughly cleaned out of the Batak lands by Atjehnese and Malay peddlers, to supply a lively demand for old china from European residents and tourists. The collecting fad has lately made it profitable for the peddlers to get their supplies of poor modern and imitation stuff from Chinese and Japanese merchants.

boeloe [22] i sagala ise mamboto tabas ni pagar
bamboo. All whoever know invocations of the protectors,

dipambaen ma disi noengon i dilibasi ma dja-
by them invocations are made there. That all done, by beating is the

boe i dohot tabar-tabar songon i ma pasal
house purified, with all kinds of purifier. In this way is the matter

toe pangoelak panabari ja pasal
(attended to) of returning to the house and purifying it. If it is a

parsili diboewat ma sagala hosea [23] gand-
matter of a substitute there are provided all manner of tall aromatic

[22] The "pictures on bamboo" here referred to are some of the *pagar* made by scratching a human (or other) figure roughly in outline on a piece of green bamboo. They are ordinarily inscribed with an invocation to a spirit. Such *pagar* were made for temporary protection at times of danger, and were placed in graves, in the thatch of houses, at the bathing place, at the spring, and in general wherever the *datoe* directed. They were afterward neglected, unless by the *datoe*'s visions it was ascertained that one of them had averted some great danger. It would then be taken care of among the prized possessions of the *radja*, or *datoe*, or *soehoet*. When such "pictures of bamboo" were prepared, they were passed around a circle of the important persons at a ceremonial and spit upon with *sirih* spittle. The writer has a few of them in his large collection of bamboo writings, and will publish illustrations of them together with transcriptions.

[23] The "aromatic herbs" known as *hosea-hosea* are all edible and strongly odorous. The word-base *hosea* seems to mean a characteristic odor, not necessarily that of a plant. Since the aromatic herbs are placed with the offering of a substitute it would seem to be with the idea of giving the *parsili* a characteristic human smell, such as would follow eating onions, etc. With the *hosea-hosea* are placed the excretions, finger-nails and hair of the *soehoet*, thus individualizing the odor of the *parsili*. If friends contribute *tondi* (soul-stuff) to the *parsili*, they give hair or finger-nails, not excreta, since their wish is to make the soul of the substitute strong, but not to give it their odor. The "worst cloth" or "worst sleeping mat," upon which the *parsili* lies, is always that of the invalid (or of the person who for some reason requires ritual purification). It is the one upon which he has lain while ill, or one which is defiled by exudations from his sores or wounds, in order that it may contribute to the *parsili* "the soul of the uncleanliness" and identify the *parsili* with the person for whom the substitute is offered. An almost full set of the *hosea-hosea* would include several as yet unidentified Zingiberaceae, namely, *lappiang, boerle* and *halawas; Zingiber sp.* (*pege*); *Kaempferia Galanga* L. (*sohoer*); *Curcuma longa* L. (*hoenik*); an herb called *leam; Allium sp.* (*bawang*); *Allium tuberosum* Roxb. (*haronda*); and *Carum sp.* (*djoeragi*). Some of these are prescribed by the *datoe* to be eaten freely in certain circumstances. Thus, if one suffers with digestive disorders the *datoe* prescribes the eating of *sohoer*, and a *parsili* made

jang sagala sandihi ni soehoet i
herbs, all manner of personal things pertaining to the body of the

diende i datoe ima gambaran ni pisang
principal. There is chanting by the "datoe." The image made of

i dilibas-libas ma dohot amboewan-amboewan
banana trunk is beaten with bundles of twigs of efficacious plants.

i dipalao ma bodari ditaroehon ma toe sirpang dohot
It is carried away at evening; it is placed at a crossway with a

andoeri [24] na ribak-ribak songon ima pasal na palao par-
winnowing tray that is worn out. In this way is the matter of making a

sili janggo palao si paembar tano
substitute gone about. If one goes about preparing the clay substitute,

ma digambar marrahit ma i toe aek
it is to be modeled as an image. It is put on a raft at the stream;

diaoeppon dipagara lilin songon i pasal na
it is set afloat; it is lit up with candles. In this way the matter of the

palaohon si paembar janggo pasalna marsahata
clay substitute is gone about. If it is a question of reconciliation

disamboli manoek sada dibaen ma indahan
there is to be sacrificed one fowl. There is to be placed cooked

diatas pinggan dibaen manoek di topi ni dahan i
rice on a plate; there is to be placed the fowl at the edge of the rice.

dibaen ma diatas andoeri dilijotton ma dohot bonang bara
It is to be put on a winnowing tray. It is to be done up with red yarn.

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for the patient must be made odorous with *sohoer*. Similarly, the corm of *boerle* is eaten after childbirth, and a *parsili* for a new mother must smell of *boerle*.

[24] The winnowing tray contains the offerings of food and drink for the evil spirit. It is used instead of a sleeping mat when a *parsili* is made for the ritual purification of a group after a funeral or after some other thing has been done for which purification is required. Generally the tray hangs from an oblique frond of sugar-palm or from a bamboo just above the *parsili*, but sometimes only *mombang* (hanging magical devices) are suspended from the palm-leaf stalk, and the tray is placed on the ground beside the *parsili*, or made the platform of a little altar. An old tray is preferred for group purification because it is identifiable by the spirits with the people for whom the *parsili* is a substitute. By long use it has acquired *tondi* (soul), from human beings and from the rice. A new one would have no recognizable association with the people, and would therefore fail to accomplish its purpose.

diboewat ma sada sondoek dibaloeti ma oedjoeng ni sondoehi
There is to be provided one spoon. There is to be wrapping put around

dohot boeloeng ni pisang dihatahon
the handle of the spoon with leaf of banana. There is some-

datoe i ma noeng salpoe dihatahon
thing to be said by the "datoe." Being completed, this speaking

datoe i didjoppoetna
by the "datoe," rice is taken by him between thumb and two fingers.

pinasahata i ma songon i ma pasalna
A sign of reconciliation is that. In such a manner is the matter

marsahata pasal mangoeras
of becoming of one accord attended to. Now for the matter of purifica-

diboewat ma sada limo moengkoer di(boewat)
tion. There is procured one fruit of the cleansing citrus; there is ob-

sada manghoek dipagoeggoeg ma pasir di topi aek i
tained one cup. There is measuring out of sand at the edge of the

dibola ma limo i diparsolotton ma hoenik na ni
river. To be sliced is the lime fruit. There is to be fastened in slits of

irisan dirasip ma
it yellow curcuma root, from the slicings (of the Curcuma) which is cut

dohot boeloeng pagar diboersik ma dohot panoeroeng i
up, with leaves protective. It (the purifier) is blown out of the

ditabasi datoe i ma
mouth, with invocations. The invocations are recited by the "datoe."

oeras i noeng salpoe ditabasi disoeroe ma
The purifier being finished as to the invocations and the praying,

diinoemna ni oeras i pitoe hali diboersikkon
there is to be drunk by him of the purifier seven times; it is to be blown

pitoe hali noeng songon i diparanggir [25] ma lan-
out of the mouth seven times. This being done, there is to be purification

[25] *Anggir* means to purify by rubbing with lime juice. One of the protective devices of the Batak is the *pagar paranggiran*, which is not infrequently seen at the path in front of a house where there is illness. In its usual form it is a receptacle for the purifying lime-juice mixture, made of the lower part of an uprooted banana plant. The underground stem is hollowed out to make a cup, and the aërial false stem is cut off three or four feet up. The *pagar* is then set

djar-landjar angka maridi ma na ni oeras i
by rubbing with the remnant. Everyone bathes who was concerned with

moelak ma toe djaboe das ro i djaboe mamahe
the purification. Returning to the house, each goes to his (own) house to

pahean na borsih ma ase donok
put on clothing that is clean in order that it be compatible with the

saoedara ni badanna
peculiar property of his body.

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like a post in the ground, and of course upside down, so that the cup is at the summit. The banana is rich in *tondi* (soul-stuff) which is communicated to whatever is placed in the cup. Hanging around the cup is a fringe of yellow palm leaflets from an unopened frond, or similar strips made from the inner white sheaths of the discarded portion of the banana plant. In the cup is placed some of the liquid purifier and some of the cut limes remaining from a purification ceremony (see Pl. IX). This *pagar* is a token of the purification of the household. However, it is not always constructed when purification has been performed, and on the contrary I have known it to be constructed when the rite of purification had not been performed. The *pagar* then serves as a substitute for the whole ceremony. The banana stem *pagar paranggiran* will be found beside the path in front of a house in which an epileptic woman is pregnant. In the old days there was a hollowed stone somewhere in the permanent ceremonial inclosure, near or under the little temple (*parsoeroan*). In this stone container, which was called the *batoe paranggiran*, was placed the purifying lime mixture that remained after certain ceremonies of purification. The stone itself was held in as great awe as though it were a *pangoeloebalang*, for it was itself the abode of a *begoe* (spirit) and was made powerful by offerings rich in *tondi*. (A picture of the *batoe paranggiran* is to be published in a subsequent article.)

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APPENDIX I

THE OFFERING OF THE *PINARILIK*, OR SUBSTITUTE FOR THE SACRED LIZARD

Although it is not mentioned in Bidin's manuscript, there is another ceremony in connection with the sacrifices to the gods and deified ancestors, a ceremony so quaint and curious that it must be alluded to in connection with the other "labors of the *datoe*." It is the offering to the gods and ancestral spirits of the *pinarilik*, an image made of rice-flour dough in the form of a lizard (*ilik*).

It is well known (11) that among many peoples of the Indian Archipelago the lizard plays a special rôle as a sacred animal. This is true of the Batak, who believe that the Earth Spirit, Boraspati ni Tano, the most beneficent of all the gods or spirits they worship, appears in the form of a lizard. One of the most common art motives in the Batak lands is the lizard, which is frequently carved on the doors of the granaries. The Batak buildings are tied and sewn together by cords, since the Batak used no nails, and commonly the stitching with cord made of sugar-palm fiber takes the form of a conventionalized lizard. In spite of all the evidence in their art (Pls. X–XII) that the lizard is held in special esteem, it must be confessed that there seems to be no unusual veneration of living lizards, nor an unusually great number of stories about the lizard. However, one very important story has been published, Nan Djomba Ilik (Toba text recorded by Van der Tunk, 10; Dutch translation by Pleyte, 9), which gives an important clue to the significance of the *pinarilik*. It deals with the culture heroine who taught the art of making open-work mats (Pl. XIII). She was the daughter of a *radja*, but was born a lizard, to the great distress of her parents. At her request a home was made for her in a great banyan tree in the forest of spirits where the great spirit Radja Tumording held sway. Here she lived with a cloud spirit as her companion, sometimes assuming the form of a beautiful princess, but resuming the form of a lizard when alarmed. She received as visitors the seven daughters of the spirit king, Radja Tumording, and taught them the art of weaving beautiful mats. Eventually her retreat was discovered by a prince. They loved each other, and lived as man and wife. The terrible fact was not learned until they went to visit his parents that her relationship to him (she was the daughter of his father's sister) would have made the marriage unthinkable if her identity had been known by the young man. (She should have been the daughter of his mother's brother.) The damage was already done, however, and the inviolable law violated, so he refused to give her up. Since the story ends with no further information except that they founded a new settlement, lived happily and had numerous descendants, we are forced to make a bold guess that the gods had to be propitiated because of the illegitimate marriage. According to Batak ideas, marriage to a prohibited relative would have required the death of the offenders. But Nan Djomba Ilik was not only ravishingly beautiful and

talented, but of supernatural origin as well, so that her death might bring calamity. To save her, would not the sacrifice of a substitute have been decreed? And may not the tradition have been established of offering a substitute for a lizard at great sacrifices to the gods and ancestors, to atone for unintentional breaches of the marriage prohibitions?

If this explanation seems far-fetched — and confessedly it does — I can only say that the *datoe* who offers the *pinarilik* has no explanation whatever to give, and neither do the other participants in the ceremony. It may be said, in defense of this explanation, that the Batak far more often offer substitutes than complete sacrifices, and that the reasoning is quite typical of the Batak. The reader who is acquainted with Frazer's fascinating account (7, pp. 86–108) of the offering and eating of dough images of animals, men and gods will find that there are many partial parallels among other peoples to the offering of the *pinarilik*. Since Nan Djomba Ilik had power to appear in the form of either a human being or a lizard, she was too close to the gods to be killed. Nevertheless she had offended against the laws of god and man, so that something had to be done about it. To offer a substitute in the effigy of an *ilik* would be appropriate, and since the body of all offerings might be consumed by the people at a sacrifice after the gods had accepted the soul, there would seem to be only an accidental parallelism to the eating of the sacrificed god as it occurs in so many religions — in Christianity, for instance. It is tempting to find a case of transubstantiation in this Batak ceremony, since it is otherwise so comparable to Brahman rice-cake sacrifices, regarding which Frazer (7, p. 89) says: "On the whole, it would seem that neither the ancient Hindoos nor the ancient Mexicans had much to learn from the most refined mysteries of Catholic theology." The Batak ceremonies are strictly, as far as there is any evidence, offerings to the gods followed by participation by the people in the sacrificial meal, and not ceremonies by which it is hoped to fortify the living by the eating of a god.

The story of Nan Djomba Ilik is one of those important ones that account for the beginning of the arts and crafts. It should have been mentioned that, while the lizard princess was living in the banyan tree and giving lessons in mat weaving to the ghost princesses, she also made presents of her handiwork for her own parents, sending them by the cloud spirit as messenger. The Batak women are preëminently successful in weaving fine pandanus mats with beautiful and complicated open-work designs at the ends and borders (Pl. XIII).

At the start of the *pinarilik* ceremony, white rice was husked and pounded by unmarried girls, chosen by the *datoe* because of their modesty and good reputation. (The pounding of the rice flour is *mandoeda topoeng*.) Then the *datoe* made the flour into stiff dough with water only and quickly modeled a lizard, which he placed in the center of a square of banana leaf. This was the *pinarilik*, or "substitute for the *ilik*." Around it he placed other little objects of dough, as follows:

Poning-poning, four round masses in front of the lizard and four behind;

Tipa-tipa, two spindle-shaped masses behind the lizard between the two pairs of *poning-poning;*

Toloer-toloer (imitation eggs), four round masses, smaller than the *poning-poning*, two on each side of the lizard between the fore and hind legs;

Toedoek-toedoek, two spindle-shaped masses on each side, next to the eggs, similar in appearance to the *tipa-tipa;*

Hoembar-hoembar (imitation receptacles for salted and spiced food delicacies) four objects, one near each foot of the lizard, cylindrical at the base, but with three dome-like protuberances at the top;

Tandjah-tandjak, two long objects shaped like a bone, wider at one end than the other, of which one was placed beyond the *hoembar-hombar* on each side of the lizard;

Hoeloehoeloek, another pair of long bone-shaped objects, longer than the *tandjah-tandjak*, one of which was placed beside each of the latter.

During the preparation of this layout, which was now placed on a winnowing tray, the women had taken some of the rice flour and made it into two kinds of cookies, known as *gaboer-gaboer* and *sagoe-sagoe*. These were wrapped in banana-leaf packages and placed on a plate near the *pinarilik*. At the sides of the winnowing tray were now placed small bamboos of palm wine stoppered with bouquets of *roedang*, the sacred herbs. The entire offering (Pl. XIV) was now presented to the gods in a long prayer by the *datoe*, although the *pinarilik* was not yet ready to be placed in the altar. Until other offerings had been cooked, it was covered over with a heap of sacred herbs and then cooked by steaming. While all this had been going on the master of ceremonies at the big iron cooking basin (*balanga*, the one ordinarily used for boiling down sugar-palm sap to make sugar) had prepared special tidbits to be cooked for the gods. Accompanied by the orchestra he and a companion squatted on opposite sides of the basin and carried out a posture dance, in which they held each pose for several beats of the orchestra. It is a dance of facial expression and arm positions and has the object of terrifying uninvited demons who might possess the participants or partake of the offerings (Pls. XV–XVI).

At the conclusion of the dance the offerings were placed within the compartments of the altar, some below and some above. They were dedicated to the gods of the upper world, the middle world and the under world in long prayers which lasted an hour or so. Then the *datoe* sat in silent contemplation with a white cloth over his head, until he had a vision that the gods had accepted the soul of the offerings. Then he solemnly chewed *sirih* with the gods, sitting before the altar, and the offerings, except the *pinarilik*, were removed from the altar and consumed by the participants. The *pinarilik* might have been eaten, but was left because it was unsalted. This ceremony was a distinct phase of the whole complex of ceremonies in which offerings were made to gods and spirits in various ways.

APPENDIX II

THE POTTERY OF BATOE BARA

The Pardembanan Batak have discontinued the manufacture of pottery, and whatever pottery is now made anywhere in lowland Asahan (the sultanate — not the more inclusive administrative unit of the same name) is made by Chinese potters. At the north of Asahan in the small coastal district of Batoe Bara there is still a small pottery industry carried on by Malays who live at a village called Kampong Pinang on the south side of the Soengei Moeka between Laboehan Roekoe and Tandjoeng Tiram. Their product consists mainly of crudely burned yellowish and black cooking pots with a poor salt glaze (Pl. XVII), but they also make for sale to their Batak neighbors of Asahan and Simeloengoen the incense burners (Pls. XIX and XX) which play so important a part in Batak ceremonial. In "The Labors of the *Datoe*" there has been mention of fumigation of the *sibaso* and his clothing, of gifts, of offerings to the spirits, and of everything that might require ceremonial purification, in the smoke of burning benzoin (*kamoenjan*) or of a mixture (called *dahoep*) containing *Ocimum sanctum* (*roedang toba*). Wherever one finds a censer it proves to have been made in Batoe Bara and obtained in trade by the Batak either at Tandjoeng Bale (which has supplied the Pardembanan group) or at Laboehan Roekoe, where the Batak of Tanah Djawa used to trade.

The censers are of two main types. One is obviously a clay imitation of the most common censer which is made in brass by the Malays of Padang (West Coast) and Atjeh. The brass type, in turn, is of a model that one may find commonly in China and Japan. It consists of a bowl-like receptacle for the burning material with a high perforated cover. The second type is more unusual. It consists of the effigy of a cock with outspread wings standing in a shallow saucer. On his back he may carry a miniature censer of the usual sort. Both types are carved with designs while the clay is wet, a style of ornamentation which, as already stated, reached a high degree of perfection with the Pardembanan, was used by the Batak of Padang Lawas (4, p. 13), and extends at least as far up the East Coast as Langkat (5, p. 197). As this method of decoration is used at Batoe Bara it is somewhat crude, being confined mainly to cutting little nicks in edges and rims. The skill shown does not compare with that of the makers of the *taboe tano* of the old Pardembanan graves.

Although the Batoe Bara ware used for ordinary purposes was salt-glazed, that for religious use was not. The latter was given a wash of red ocher and then dotted all over with little spots of white lime. Some of the pieces obtained by the writer in 1927 (the collection shown in Pl. XIX, now in the Raffles Museum, Singapore) were not painted, but simply because the process of manufacture had not been completed.

In addition to the censers there are several types of small dishes that would appear to be bric-a-brac, as far as the Malays are concerned, but to be used by the pagans as containers for special offerings on the occasion of great religious

ceremonies. Such are the little covered dishes in the shape of a mangosteen fruit (*boewa manggis*), closely fitting in saucers (Pl. XX, Fig. 1, upper left), and the flat oblong dishes with the cover in the form of a setting hen (Pl. XX, Fig. 1, front center), the whole dish representing a hen on a nest, and so absurdly identical with the setting-hen glass mustard dishes which are found in all of our American "antique" shops, but which date only from thirty-five or forty years ago, that it could be imagined one had provided the model for the other. (A concrete example of identical, widely separated "inventions" for the culture diffusionists to worry about!)

The Malays do not use the remarkable pottery roosters themselves, so far as I could discover. They call them *pabaraan manoek* or *parasapan manoek* (fowl censer). If one may be permitted to speculate a bit, it seems a fair inference that they are a survival from pre-Islamic days, that they were formerly used more by the Malays themselves than they are at present, and that the survival of their manufacture is to be attributed to the demand for them from the pagans. Certain Malays said that the "roosters" were the "*boeroeng garoda*," the great bird of Hindu mythology, which carried Vishnu's car. This idea is supported by the presence of the minature censer on the bird's back. But whatever he may have been centuries ago, he is now a cock pure and simple, to those who model him and to those who buy.

The representation of Batoe Bara pottery listed in the catalogue of the Leiden Ethnographic Museum (6) was derived from an industrial exhibition held in Batavia in 1893. It consists mostly of small models of large articles for everyday use, which would ordinarily have been salt-glazed, but, being models, undoubtedly made at the request of a European official, some at least are ocher-washed and white-spotted that should not be. The collection is interesting as a record of some articles of house-ware that seem to be no longer made, but it lacks some of the small articles for pagan ceremonies. It contains (6, p. 150 : 1008/116) a "censer of burned clay, in the form of a bird sitting on a dish; this entirely covered with incised spirals and triangles; on the back a round little pot with dentate edges and a cover done with spirals; the edge of the dish dentate and with a vase-shaped extension closed with a round lid; all colored red and white. Laboean Ruku. H.13, Dm. 22 cm."

A chapter by Jasper (5) in Colijn's *Neerlands Indië* (1913) figures four typical pieces of the ceremonial ware, exactly similar to some of those obtained by the writer in 1918 (Pl. XX) and 1927 (Pl. XIX). The former collection is in the writer's possession, the latter in the Raffles Museum, Singapore. The figures in Colijn's work also illustrate two examples of Langkat pottery; one, a water-bottle, remarkably similar in decoration to the Pardembanan grave bottles, but with a realistic lizard (*ilik*) modeled on the top, the other a censer similar to the simple dish type of Batoe Bara, but a two-storied elaborately made one on a stand, the cover supporting an elephant (?) at the top, which in turn, bears a miniature censer with a bird on the cover. The Pardembanan ware is said to have been made long ago at Pinggan Mardjawa. There is little reason to doubt that pottery of similar general characteristics was made all along the eastern edge of the Batak lands wherever there was contact with pre-Islamic Malays. Batoe Bara was originally a Menangkabau colony, according to tradition, which is verified by relics of the Menangkabau division into "four quarters" (*ampat soekoe*).

The pottery at Kampang Pinang is made on a very primitive wheel. Two cylindrical blocks of wood from the same log of close-grained heavy wood are so cut that a cylindrical peglike projection of one fits into a corresponding hole in the other (Plate XVIII). The lower block is buried level with the upper surface, which is lubricated with clay and water, so that the upper block may be rotated on it by the use of hands or feet. The worker squats on the ground at an occupation which is anything but neat. A potter's wheel from Kampong Pinang obtained by the writer is in the Raffles Museum. It is probably as primitive a one as may be found in the world.

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VERNACULAR INDEX

This index corresponds to the one in Part I (11 : 66–74) and gives page references to places where the ethnologically important or philologically interesting words occur. It is followed by an English index without page references, which can be used in conjunction with both vernacular indexes.

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ENGLISH INDEX

This index is designed to help a reader who is interested in a definite topic, such as the conception of soul-stuff, to find quickly whatever the two parts of "The Labors of the Datoe" may have for him. It is in no sense a vocabulary. The English entries are merely catchwords which will enable the two vernacular indexes to be consulted.

altar
  andjapan
  pandaongan
ancestral spirit
  begoe ni hoela-hoela
  ompoe
  padjoean
  padjoepadjoean
  simangot
animals, sacrificial
  babi
  balijang
  hambing manoek
  manoek tĕgas
apparatus, ceremonial
  ramoewan
arch, of ceremonial inclosure
  pintoe godoeng

aromatic plants
  bawang
  boerle
  djoeragi
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arrangements, for ceremony
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  topeng
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  adjimat
  desa nawaloe
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  takkal
chief
  radja
clearing, forest
  djoema
  ladang
clothing
  hijo

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coffin
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bonang toloe roepa
boras toloe roepa
hijo poeting
kasoemba
compass, points of
desa nawaloe
controller, magical
adji
adjimat
cooking, without salt
bolgang
corpse, carried back and forth
oendar-oendar
cross-way
sirpang

dancing, ceremonial
manotor
moensak
parmoensak
patortorhon
delusion
nipi
demon
begoe
djin
sinoemba
demon-possession
halak na sorpoon
desire, sensual
sir
dog, ill-omened, as sacrifice
bijang sijal tong
dream
nipi
parnipinipiwon

drumming
diondasi
manggoeal

egg, ceremonial use
toloer
euphemism
haoe-haoe
excreta, etc.
sandihi

fate
oemmiran
feast, ceremonial
kandoeri
manggalanggalangi
mangoepa hoela-hoela
fertility rite
takkal pamoepoes
fine
oehoem
toboes
flour, rice
tepong tawar
topoeng
flowers, ceremonial
boenga
hatoenggal
fowl
manoek
fowl, censer in form of
parasapan manoek
friend, intimate
pedan
friendship
dorma
marsahata
marsiroedangan
parsahabaton
fruits, representations of
boewa manggis
boewa galoegoer

genealogy
tarombo

ghost
begoe
simangot
gift
djakki
djoewal
oepa
pinarsaloeksoeng
poesaka
gods
debata
simangot
soeroengan
sombaon
grave
anisan
djerat
hadjang palis
kĕramat
parsimangotan
pondom
tanoman
guardian spirit
djinoedjoeng
pagar
pangoeloebalang
parorot

haruspicy
parmanoehon
heart
roha
heart-beat, premonitory
gorak ati
hearth, of burial mound
dapoer
heirlooms
poesaka
herbs, medicinal
tambar
tawar
herbs, odoriferous
hosea-hosea
herbs, sacred
roedang
horn-bill, mask resembling
hoeda-hoeda
koeda-koeda
horse, mask resembling
hoeda-hoeda
house
djaboe
household spirits
ambangan
begoe monggop
djinoedjoeng
djoembalang tano
house-yard
alaman
human sacrifices
biaksa
pangoeloebalang
toenggal panaloewan

image
gambar
gambaran
gana-gana
oegas ni tondi
paembar
pagar
pangoeloebalang
parsili
toenggal panaloewan
incantation
tabas
incense
dahoep
kamoenjan
inclosure, demon-excluding
mare-mare
parhordjaan
pintoe-godoeng
silang
infant, deified spirit of
haenggalan

invalid
  naboritan
invitation
  pinangan ni ara
  pijo
invocation
  soeroe
  soeroeng

jewelry, heirloom
  poesaka
  tintin

labor, a ceremonial
  hordja
leaves, medicinal, etc.
  boeloeng
lime (fruit), purifying
  limo
lizard
  djoembalang tano
  ilik
  pinarilik
love, ceremony to secure
  holong ni roha
love charms
  parnipinipiwon
love-making
  dorma

magic
  hadatoeon
magician
  datoe
  goeroe
manners
  dorma
manuscripts
  poestaka
marriage group
  hasoehoetan
  hoela-hoela
  marga
masks
  hoeda-hoeda
  topeng
mat, sleeping
  lage
medicinal plants
  tabar
  tambar
  tawar
medium
  sibaso
music
  diondasi
  ende-ende
  goewal
  lagoe
  manggoeal
  saroene

nations, of spirits
  bangsa
  djinoedjoeng
  padjoe-padjoean
numbers, even
  sikko-sikko
numbers, odd
  ari na pitoe
  bonang toloe roepa
  boras toloe roepa
  gandjil
  hata na sada
  hata na toloe
  pitoe hali

odor
  hosea
  sandihi
oil
  minak
offer
  makkirap
  mambere
  mamele
  mangkahoeli

offer
  mangoepa
  manggalanggalangi
  marboenga nasi
offering place
  andjapan
  boeloeng ni bagot
  borotan
  haenggalan
  mombang
  pandaongan
  pangoembari
  parpagaran
  parsimangotan
  parsoeroan
  pinangan
  sakkak-sakkak

path
  dalan
peculiarity, of odor or spirit
  saoedara
placenta, soul of
  adek ni tondi
plants, aromatic
  hosea-hosea
plants, ceremonial
  andoedoer
  bagot
  boeloe soma
  hatoenggal
  hotang
  roedang
  siala
plants, magical
  balik hoenda
plants, protective
  boeloe soma
  boeloeng pagar
plants, purifying
  amboewan-amboewan
  limo
  tambar
  tawar

poison
  arsik ngarngar
  bisa
poison, antidote for
  soeboetan
post, sacrificial
  borotan
prayer
  manomba-nomba
  soeroe
  soeroeng
  somba
priest
  datoe
  goeroe
principal, in ceremonies
  soehoet
prohibition (tabu)
  pantang
propitiation
  sakkoet
protector
  boeloe soma
  boeloeng pagar
  pagar
  pangoeloebalang
purification
  amboewan-amboewan
  anggir
  batoe paranggiran
  daoen limo
  libas
  limo
  mamambangi
  manabari mamappasi djaboe
  manabari manggoeal toba
  mangambangi
  mangoeras
  oeras
  pagar mangoeras
  pangori tapijan
  paranggir
  tabar
  tambar

tawar
tepong tawar

raft, to float away with evil
rahit
ransom
toboes
reconciliation
marsahata
pinarsahata
relationship, terms of
abang
adek
age
ama, amang
anggi
hasoehoetan
hoela-hoela
ibereon
ina, inang
kaka, kakak
marga
ompoe
oppoe
oppoean
padjoe-padjoean
pariban
saoedara
siabangan
sianggijan
soedara

sacred herbs, exchange of
marsiroedangan
sacrifice, human
biaksa
pangoeloebalang
toenggal panaloewan
salt, offerings without
bolgang
serpent
baganding
naga
soot
badja
soothsaying
oehoem sorik sorgah
oelpoehan
soesa saloesoe
soul, soul-stuff
tondi
speech
hata
spirit
ambangan
begoe
boraspati in tano
boroe golom ari
boroe sanijang naga
djin
djinoedjoeng
hantoe
homang
monggop
ompoe
padjoean
padjoe-padjoean
pangoeloebalang
parorot
simangot
sinoemba
tondi

spitting
boersik
gambaran ni boeloe
staff, magic
toenggal panaloewan
stars, called to witness
bintang
substitute offerings
anisan
djakka
paembar
parsili
pinarilik
toboes

teacher
goeroe
teeth
badja
ipon-ipon
parbadjabadjaon
pargiowangan
temple
parsoeroan
thread
bonang
tiger, were-tiger
arimo
babijat
barlindoeng
begoe
tokens, personal
parnipinipijon
parnipinipiwon
sandihi
trees, sacred
baringin
village
hoeta
parroemahan
visions
haidahan
pangidahan

woman
boroe
weather
ari golap
inganan ni ari
winnowing tray
andoeri
worship
manggalanggalangi
marboenga nasi
mardebata
marpimanggalanggalangngi
soeroeng
somba

PLATE I

FIG. 1. A scene in the *topeng-hoeda-hoeda* dance preceding the removal of the coffin containing the *parsili* from the house of the chief. The sword dancer is on the right, the *hoeda-hoeda*, a masked figure representing the horse, in the center, and the masked retainer, *topeng*, his arms extended by wooden hands, on the left. Silo Maradja, Asahan, 1927.

FIG. 2. Another view of the *topeng-hoeda-hoeda* dance. Note that the carved wooden head of the *hoeda-hoeda* (= *koeda-koeda* — "something like a horse," the reduplication signifying resemblance, as in Malay, and never, as foreigners erroneously suppose, plurality) is like that of a horn-bill, not a horse. The horn-bill head itself might be used if one could be obtained in time. The colors of the cloth of the *koeda-koeda* are white and Turkey red (*kasoemba*). In this picture the wooden hands of the *topeng* show clearly.

PLATE I

FIG. 1. *Topeng-hoeda-hoeda* dance

FIG. 2. Profile of *hoeda-hoeda* shown in Figure 1

PLATE II

FIG. 1. Coffin containing the *parsili* ready to be carried away from the chief's house on the *roto karadjaan* (royal bier). Note at the right the oblique railing (*tardas*) for the house ladder, hung with *gaba-gaba* (see note 13). The poles by which the bier is carried have ornamental caps made of cloth. Shading the coffin (*djilitan:* euphemistically referred to as *haoe-haoe* — "something related to a tree") is the *hadjang palis*, magical rain-defying barrier (see note 17). Silo Maradja, 1927.

FIG. 2. The start of the funeral procession of the *parsili*, preceded by the sword dancer, the *topeng* and the *hoeda-hoeda*, dancing as they go. Silo Maradja, 1927.

PLATE II

Fig. 1. Removal of the *parsili* to the bier

Fig. 2. The start of the procession to the grave

PLATE III

FIG. 1. The procession has arrived at a crossway, where the coffin is buried so that the lid remains above the ground level. It is covered by the *hadjang palis*. The dance continues with great excitement until the ceremony is concluded by the explosion of bamboo bombs (*marsoen;* Malay *mĕrtjoen*). Silo Maradja, 1927.

FIG. 2. The wooden hands of the *topeng* dancer have handles by which he can grasp them firmly. His own arms and hands and the handles of the wooden hands, down to the wrists, are wrapped in white cloth. His arms thus appear to be grotesquely elongated, and as he dances he clicks the wooden hands together in time with the music. Silo Maradja, Asahan, 1927.

FIG. 1. Dance after the burial of the *parsili*

FIG. 2. The *topeng*

PLATE IV

Datoe na Bolon of Goersinga (= Goeroe Singa), Karoland in the costume of the *topeng* dancer. This picture was taken in the permanent ceremonial inclosure at the foot of Dĕlĕng Koetoe, where Datoe na Bolon lives alone in a house with the ceremonial apparatus. In Karoland the masks are in the permanent custody of the *datoe,* and, as this photograph and the following show, are very carefully made and finely finished. They are not left at the grave, and as far as could be ascertained, their use at funerals was much in the nature of a dramatic performance. In this picture the wooden hands show admirably in one of the most characteristic postures of the dance. Thrust in the ground (at the right of the picture) is the magic staff, *toenggal pĕnaloewan.*

PLATE IV

Datoe na Bolon of Karoland as *topeng*

PLATE V

A companion picture to the last. Datoe na Bolon in the *koeda-koeda* mask. As in Asahan, the head is made to resemble the horn-bill, not a horse. Near Kampong Goersinga, Karoland, 1927.

PLATE V

Datoe na Bolon of Karoland as *koeda-koeda*

PLATE VI

FIG. 1. *Hadjang palis*, a temporary grave shelter of cloth or paper, the intricate design of the magically significant fringe being made by cutting the folded material. Funeral of the wife of Toea Radja, Ihat Pane, Asahan, 1918.

FIG. 2. The cloth known as *hijo marsitogoetogoean*. Length 25 in.; breadth 16 in. The center consists of indigo stripes alternating with narrower white stripes. The borders are not exactly the same, but both have a very broad stripe of red near the edge, within which are symmetrically arranged narrow stripes of red, white and blue. Some of the "white" stripes may have been originally dyed, possibly with yellow, which is frequently substituted for red, but the color is entirely faded, so that nothing can be made out except that some of the whites are dull. The woof is an alternation of two white threads with two somewhat heavier indigo threads.

The magical significance of the uncut fringe is explained in note 7.

FIG. 1. Temporary grave shelter, *hadjang palis*

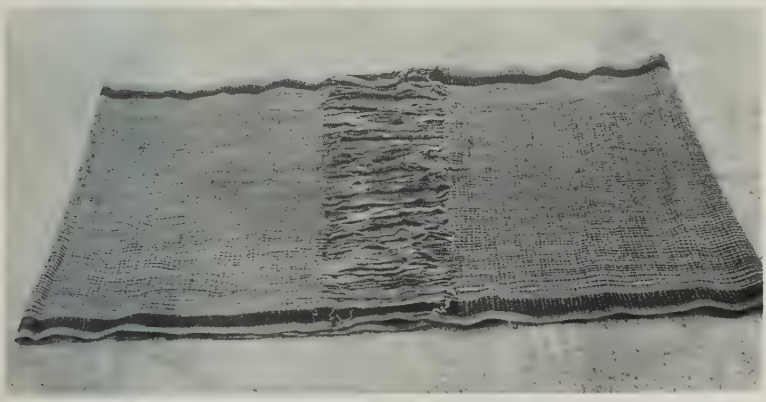


FIG. 2. The cloth called *hijo marsitogoetogoean*

PLATE VII

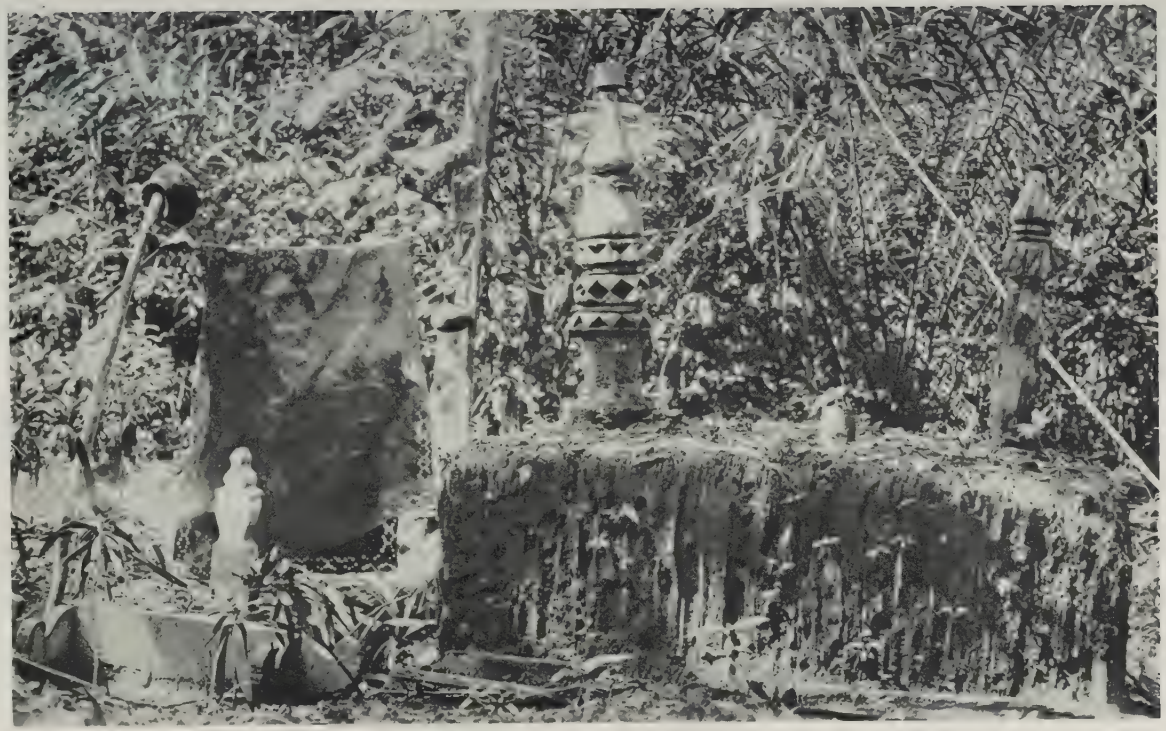
Grave-post (*anisan*) of elderly man of importance. The significance of the carvings is explained in note 19. Silo Maradja, Asahan, 1927.

PLATE VII

Typical pagan grave-post of male form, Asahan

PLATE VIII

Pagan grave (right) and recent Muslim grave (left). The frame that originally supported the old grave mound has rotted away, but it is matted together by roots and maintains its form. There are two posts because one was made hurriedly and, later, a better one was carved, but the first allowed to remain. The Muslim grave is interesting as showing very definite pagan survivals. (Compare 4, Pl. II, Fig. 2.) The sleeping mat of the deceased woman is hung diagonally across the grave. (If the mat were not so used, an old cloth of the deceased would be.) On one of the poles supporting the diagonal clothes-line is the cooking pot, ordinarily represented among the carvings of the pagan grave-post, and hanging from the other pole is a gourd of water. The frame of the grave is in a common pagan style, and as a matter of fact the only distinctively Muslim feature of the grave is the use of the two "new-fashioned" grave-stones. The features of Malay (Muslim) burial have been dealt with elsewhere (4). Silo Maradja, Asahan, 1927.



Muslim and pagan graves, Asahan

PLATE IX

Pagar paranggiran of inverted banana stem, as erected to contain the last of the purifying liquid remaining after a general purification ceremony, or as set up specifically for the protection of an epileptic woman during her pregnancy. Silo Maradja, Asahan, 1918.

PLATE IX

Pagar paranggiran

PLATE X

FIG. 1. Three of the stone figures called *pangoeloebalang*, collected in Karoland. (The white patches on the tops of the heads are the paper labels.) Batak Museum, Raja, Karoland.

FIG. 2. The middle one of the three *pangoeloebalang* in Figure 1, from the back, to show the carving of the lizard, *ilik*. Batak Museum, Raja, Karoland.

PLATE X

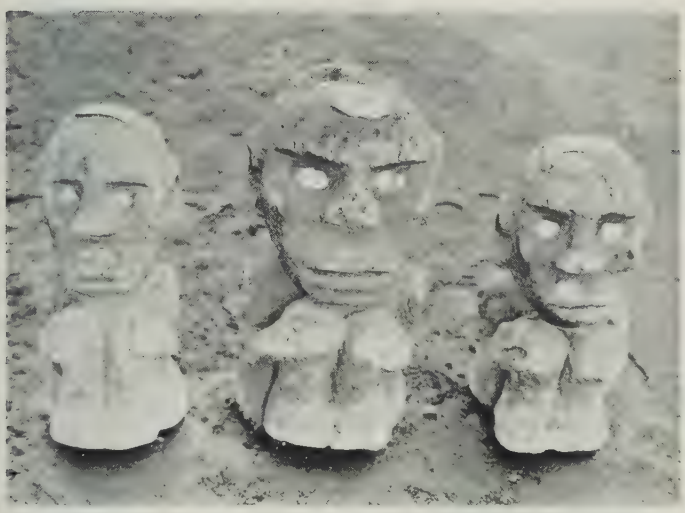


FIG. 1. Three stone Karo *pangoeloebalang*

FIG. 2. *Pangoeloebalang* with *ilik* on back of head

PLATE XI

Two views of an ancient stone rice block at Kampong Sakkar ni Hoeta, near Balige, Toba, photographed 1918.

Fig. 1. The front, showing the same sculptured head that is frequently found on the sarcophagi and the house fronts.

Fig. 2. The back, showing the lizard, *ilik*, which is sculptured or drawn on protective devices, and especially frequently upon granaries or other structures concerned with rice.

FIG. 1. Front of stone rice block, near Balige, Toba

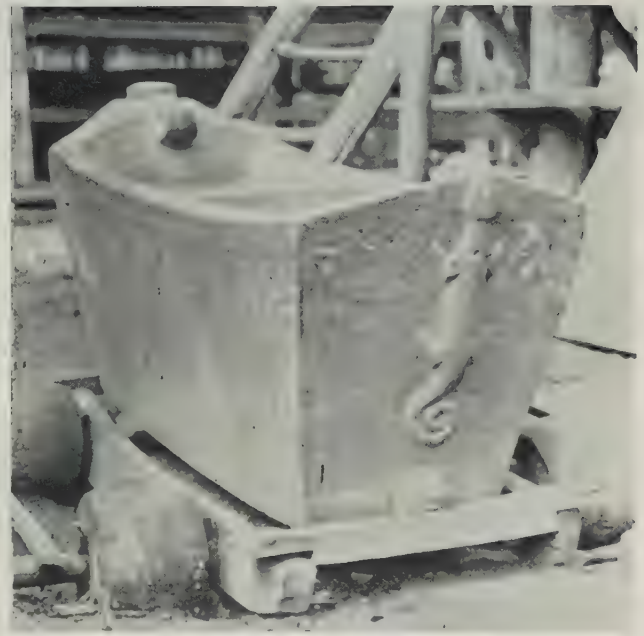


FIG. 2. Back of same block, showing carving of the *ilik*

PLATE XII

Granary at Kampong Kĕling, Karoland, 1918, showing wall boards sewn together with black fiber (*idjoek*) of the sugar palm, in the form of a conventionalized lizard, *ilik*. Two of the chiefs (*sibajak*) in the foreground.

PLATE XII

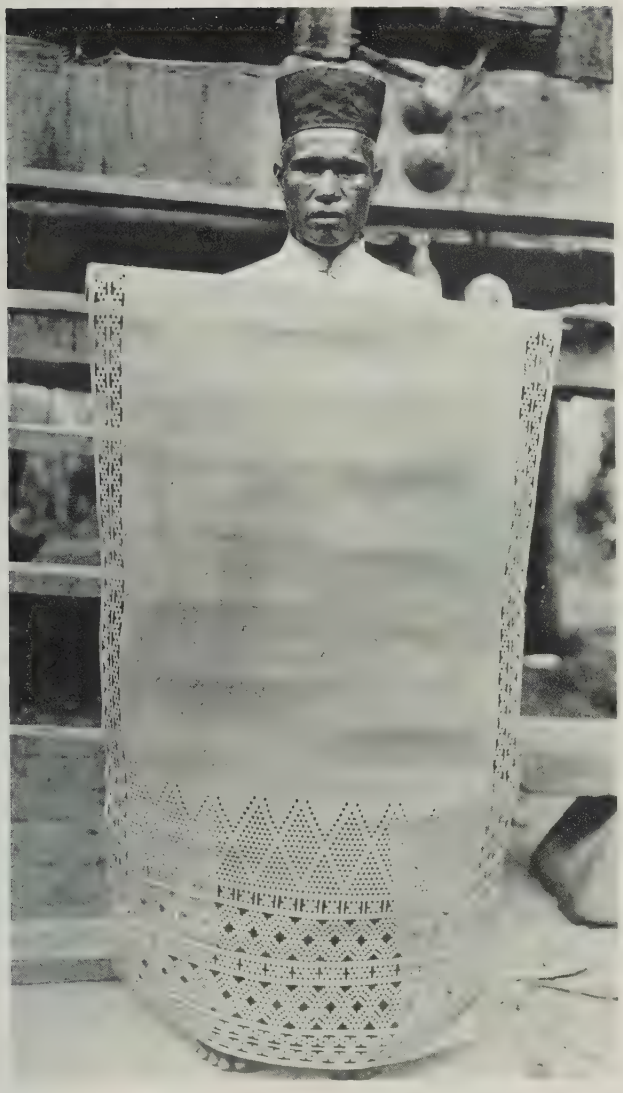
Boards of Karo granary sewn together with cords of *idjoek* fiber so as to make a conventionalized lizard design

PLATE XIII

Datoe Alok of Tangga, Asahan, displaying a sleeping mat (*lage na ni roewang: lage na marpoesoek*) woven by his wife. This specimen is now in the writer's collection. Such mat weaving as this is supposed to have been taught by the legendary princess Nan Djomba Ilik, who was born a lizard.

This plate is interesting as adding a portrait of another pagan *datoe* to those given in Part I. Si Alok is not only *datoe* but also a village chief. He had been almost blind with trachoma or a very similar disease, and was cured by the writer's *tambar na gerger* ("red purifier" — mercurochrome!). He was a helpful companion during a botanizing trip from Asahan to Dolok Soeroengan in Habinsaran.

PLATE XIII



Mat woven in the manner taught by the legendary
Nan Djomba Ilik

PLATE XIV

The *pinarilik* (rice-flour-dough image of a lizard), ready to be cooked by steaming over the big iron kettle of boiling water. It has various dough accessories which are explained in the text. The square on which it lies is a section cut out of banana leaf, placed on a winnowing tray (*andoeri*). The other offerings are a plate of little leaf packages containing the rice flour cookies called *gaboer-gaboer* and *sagoe-sagoe*, and two bamboo tubes of palm wine, stoppered with bouquets of sacred herbs, *roedang*.

PLATE XIV

The *pinarilik*, sacrificial substitute for the sacred lizard

PLATE XV

A scene in the posture dance at the cooking place of the substitute for the sacred lizard. The dance is to honor the lizard spirit and to drive away demons who might desecrate or defile the offering. Silo Maradja, Asahan, 1927.

Posture dance at the cooking place of the *pinarilik*

PLATE XVI

Two views of Si Djonggol in the posture dance at the cooking of the *pinarilik*. He frequently presides at the cooking in ceremonies of *marga* Si Rait Holboeng, his wife, Si Taetek, a sister of Bidin and niece of Datoe Silotonga, being a member of this marga. Silo Maradja, 1927. (In Part I, description of Pl. II, Fig. 2, Si Djonggol is inadvertently referred to as "brother" of Bidin instead of brother-in-law, which is his true relationship. The mistake of using relationship terms loosely is very easy to fall into, for Bidin would call either a brother-in-law or blood brother, if older than himself, *abang*.)

Si Djonggol in charge of the cooking of the *pinarilik*

PLATE XVII

Scene at Kampong Pinang, Batoe Bara, showing common types of pottery, mostly rice bowls, stored under a house. After drying, the unburned pottery is stacked up under the house until enough accumulates for a burning. It is then placed in piles of dry brush wood and burned in the open, without any kiln. While still red-hot it is glazed by being sprinkled with a salt which the Malays buy from Chinese traders. (Probably the wily Chinaman's trade secret is to sell common salt at a good high price.) The burned pottery is yellow, blackish or mottled, and in spite of its crude appearance gives good service.

PLATE XVII

Malay pottery, Kampong Pinang, Batoe Bara

PLATE XVIII

FIG. 1. The entire apparatus of a Malay pottery. The clay, after being beaten with the heavy paddle on the board at the right is thrown by spinning the heavy wheel with hand or foot.

FIG. 2. The construction of the Malay potter's wheel. The turn table is removed from the lower block and turned upside down. The wheel has a hole to fit the peg in the lower block. When the peg wears away too much, the hole is made to fit again by a packing of greased cloth, or tightly plugged with hard wood and carved out again. The potter's wheel is cut from hard wood with only knives and a Malay axe (*bělioeng*) for tools. Kampong Pinang, Batoe Bara, 1927.

FIG. 1. Malay potter's wheel, mixing board and paddle

FIG. 2. The same, showing construction of the wheel

PLATE XIX

A display of censers (*parasapan; pardahoepan*), at Kampong Pinang, Batoe Bara. When the writer visited the village in 1927 these were burned but not yet painted red and spotted with white. Since there was no likelihood that I would be able to return, they were bought as they were, unpainted. (They are now in the Raffles Museum, Singapore.)

PLATE XIX

Censers (*parasapan*) photographed at Kampong Pinang, Batoe Bara, 1927

PLATE XX

FIG. 1. A collection of censers and dishes for offerings made at Kampong Pinang, Batoe Bara, in 1918. The ceremonial pottery is not glazed, but painted red with a suspension of red ocher in rice water. It is then spotted with lime. The dish in the middle of the front row is unpainted. Such dishes as this, and the one on the back row at the left are used by the pagan Batak as receptacles for choice offerings which are placed in the *parsoeroan* or the *andjapan*.

FIG. 2. The most elaborate type of censer — really a combination of censer and dish for offerings. The bird, with outspread wings, bears a censer on his back. He stands in a shallow dish, to the rim of which is attached a small dish. To the Batak the bird is merely *manoek* — "a fowl." Some of the Malays thought it was the "*boeroeng Garoda*," Vishnu's bird, which bore his car on its back.

It would seem that this ceremonial pottery has no longer any significance for the Muslim Malays. If the pagans did not buy pieces occasionally it would no longer be made. It is found for sale in Malay shops in Tandjoeng Bale and Laboehan Roekoe.

FIG. 1. Malay censers and dishes for offerings

FIG. 2. The bird censer, *parasapan manoek*

INDIAN PIPES COLLECTED IN SAGINAW COUNTY, MICHIGAN

FRED DUSTIN

IN VOLUME I of the *Report of the United States National Museum for 1897* Joseph D. McGuire contributes a paper of about three hundred pages, illustrated by over two hundred cuts, on "Pipes and Smoking Customs of the American Aborigines." His work was based on the rich collections of the National Museum and covered the entire area of the United States. His studies indicate that certain types were common in large sections of the country, but that others appear to have been localized, as, for instance, a peculiar slender form plentiful along the Atlantic Coast; the catlinite or red pipe-stone pipe of the Siouan type was plentiful between the Great Lakes and the Missouri River.

On the other hand, certain types appear to have been widespread in their distribution, and we find that north of the 35th parallel, which forms the southern boundary of Tennessee, and east of the Mississippi River the "monitor" and bowl- and vase-shaped types are both numerous and characteristic.

After a study of Mr. McGuire's paper I was somewhat surprised to find that my own little collection, gathered from the fields of Saginaw County, contained specimens representing half a dozen or more different types, and that I had seen still different forms in the hands of others. It seemed worth while to describe these widely different pipes and I prepared a paper which later appeared in a local daily.[1] Since that time, I have collected several others and I believe that a description will be of interest to collectors, as well as a slight contribution to the archaeology of the region.

In a paper on ancient pottery remains,[2] I noted the individuality

[1] *Saginaw Courier-Herald*, November 16, 1913.

[2] "Ancient Pottery Remains in the Saginaw District, Michigan," *Pap. Mich. Acad. Sci., Arts and Letters*, 10 (1928): 69–77.

of the potters as expressed in ornamentation. This is equally marked in the pipe-maker, and while certain types have been evolved, the individual workman has impressed or carved his personality upon most of his work. Though the making of pottery was the woman's work, we know that pipe-making was a masculine trade, at least as far as the stone pipe was concerned, and quite probably the man also formed those smoking utensils that were made from clay or from pottery mixtures, but we may well believe that the woman, with her deftness in the manufacture of pots and vases, also did her share in pipe-making.

I have deposited the larger portion of my collection in the Butman-Fish Library in Saginaw; on looking it over not long ago I saw that it numbers about thirty pieces, which consist of several perfect pipes; some whole bowls, but with stems broken off; complete stems without bowls; and fragments of both stems and bowls (Figs. 20–23). It so happens that I have never found a catlinite pipe, and there is not one in the whole collection for which the material could not have been procured within fifty miles, although the variety is quite remarkable. In these articles the Indian was quick to learn the relative value of the different rocks and minerals; some would crack or splinter from heat; others were too porous, and still others were too hard to work. We find, in consequence, that in general the stone pipes were fashioned from an argillaceous rock or from sandstone of fine texture, since both of these rocks are to be found outcropping in the bed of the Cass River in the vicinity of Cass City in Tuscola County.[3]

On the other hand, it is safe to say that from one half to two thirds of all the pipes or fragments of them that might be collected in this county would be of pottery material, the base for which was more easily procurable than stone. This would likewise apply to the whole Lower Peninsula. Bearing in mind that our stone pipes were usually provided with reed or wood stems, we shall understand that a perfect stone pipe would be the rule, and that a perfect pottery pipe would be the exception, as bowl and stem were all formed in one piece, and, owing to the fragile character, easily

[3] C. Rominger, *Geological Survey of Michigan, Lower Peninsula, 1873–76*, 3 : 104.

broken by the combined effects of frost and water, as well as by the tools of the cultivator. The average collector, in consequence, passes over broken bowls and stems of pottery without even recognizing their character. He is looking for "calumets" of the red pipe-stone, so conspicuous by its color and striking in form and figure, which he finds, buys or trades with avidity. More especially is he delighted if he secures one inlaid with lead bands and patterns, not knowing that he has a comparatively recent article and one in which the white man's culture is so obvious that the archaeologist can only smile at his enthusiasm, hesitating to tell him that the aborigines were not smelters and that metallic lead does not occur in nature. "Calumets" are not wanting which have been made "for the trade" by white men, and in the Butman-Fish Library may be seen a beautiful catlinite tomahawk pipe ornamented in a way that no primitive Indian ever thought of. It was sold to an innocent buyer as of "genuine Indian make," but the first letter of the last word should have been *f*.

Rarely a pottery pipe is taken from a grave or mound in perfect condition. Except for the pipes on exhibit as mentioned, my collection is packed away in such a manner as not to be easily examined, but I should say that the total represents at least fifty different specimens, of which a few will be described. McGuire's paper will be used as a basis for types and general descriptive terms.

I have seen a number of catlinite pipes collected in this county, but I shall describe only one, that owned by Mr. Henry Bornhoff, of Saginaw, since it will serve as a fair example of its kind showing primitive craftmanship. It may be said in passing that the pipe-stone from the noted quarry in Minnesota was an article of traffic, and also that long journeys were made to its source, where it was quarried and brought south by different tribes.

The catlinite pipe owned by Mr. Bornhoff (Fig. 11) was collected near Garfield at about the center of Swan Creek Township. In outline it somewhat resembles Figure 177 of McGuire's paper, but does not have the projecting tip. The bowl is two inches high and three inches long. The hole in the bowl is cone-shaped and is three fourths of an inch in diameter at the top; the hole in the stem is nearly half an inch in diameter at the opening. The bot-

tom of the pipe is flattened, and on top of the stem is a slightly raised surface seven eighths of an inch along the length of the stem, which is ornamented with four V-shaped grooves at right angles to the length. There is no other decoration. A former owner of the pipe dropped it, breaking the bowl from the stem. He set to work to repair it in a quite ingenious manner, and in consequence a person not knowing the facts would suppose it to be one of the recent "leaded" pipes. He cut shallow grooves around stem and bowl and four connecting grooves from one to the other and then ran in hard lead, which was afterward worked to an even surface with the pipe and smoothed, making a very neat repair. The notches mentioned appear to have been made with a stone tool, and the finishing seems to have been a process of scraping to a fairly smooth surface, although the inequalities may be easily felt by passing the fingers around the bowl. I should say it was of prehistoric manufacture.

McGuire says that primitive catlinite pipes bore little or no ornament. So far as my own observation extends, nearly all the ancient pipes of this material were of the Siouan type, strikingly alike in general form and workmanship, but showing the individuality before noted. It seems probable that their production was largely in the hands of the Sioux, and that those which drifted south and east were in large measure incidental to trade or war. On the other hand, we find totemic figures and other objects not at all pertaining to the Siouan culture fabricated from this pipestone, and scattered far east and south. I have a finely worked little beaver and also a lump of the raw material showing cutting, which I collected on village sites, and there is little doubt that the Chippewa, after pressing the Sioux out of the Upper Peninsula, visited the quarries and procured the stone.

Catlinite is quite soft, being between calcite and ordinary slate in hardness, and is easily shaped. McGuire calls it an indurated clay, which is technically correct, but its peculiar characteristics are such that it has been classed as a specific mineral under the name above. Its principal source was the noted quarries in Pipestone County, Minnesota.

Figure 15 is an interesting specimen of a modified Micmac type,

and is a perfect little bowl over an inch and a quarter in length and three quarters of an inch in outside diameter. The material is a fine argillaceous stone. It has the typical keel of the Micmac pipe; through it a hole has been drilled to receive a cord or thong for attachment to the person or belongings of its owner. The perforation for the stem is not through the base, but into the bottom of the acorn-shaped bowl. This is ornamented with shallow drilled pits in quite regular forms and patterns, such as two half-circles evenly spaced. The bottom of the keel or base and its thin edges are also decorated with shallow pits. The receptacle for the smoking material is funnel-shaped, and this is true of nearly all those in the collection.

Figure 9 is a rather crude specimen of the potter's art. It is a bowl from which the stem has been broken, and is of the Iroquoian type, resembling Figure 113 of McGuire's paper, although the bowl tapers more from top to bottom. There are three ornamental lines around the top, which is one and one-quarter inches in diameter, and the bowl is one and one-half inches high from the upper curve of the stem. The ware is quite fine in texture, and appears to contain a tempering material.

Figure 4 is typical Micmac, and was found not far from the specimen shown in Figure 9. There remains only the lower part of the bowl; the base is nearly perfect, but the keel is broken off through the thong hole. This was a fine pipe, and closely resembles Figure 102 of McGuire's paper.

The material is gray sandstone of fine grain. The stem hole is perfect, and the cone-shaped section of the inside of the bowl shows the marks of the rude drill employed in fashioning it.

Figure 16 is a rare little pipe, a perfect bowl of argillaceous stone, three fourths of an inch long by seven sixteenths in its greatest diameter. Did we not know that the Indians sometimes used very small pipes, we would at once class it as a toy, and perhaps it is such. It is wedge-shaped, with the edge of the wedge parallel to the line of the stem and forming its base. It is a type not figured by McGuire, but is most probably duplicated in museums, although it is the only one I have seen.

Figure 18 is of interest, as it shows a pipe in the making. It is a

diminutive little object much resembling McGuire's Figure 147, although the stem portion is shorter and its material is a clay rock. Its extreme dimensions are about five eighths of an inch, both length and height being about the same, while the diameter of the bowl is one-half inch and the stem portion three eighths of an inch. The bowl has been drilled to about half the required depth, also the stem, but in the process a crack developed in the latter and the work was left unfinished.

The specimen shown in Figure 10 was collected on the Frazer Village site[4] and closely resembles McGuire's Figure 48, although not quite so ovoid. The material is a gray sandstone containing small pebbles, so that it might be classed as a conglomerate. The hollow for tobacco is quite small as compared with the size of the bowl, and bears the marks of the tool used in forming it, as does the outside of the bowl. Its length is two and one-fourth inches and the diameter is one and one-quarter inches. It is quite symmetrical and is a good example of the ovoid type.

On account of its place of deposit and associations, Figure 14 is one of the most interesting of the whole collection. Like Number 8, it was found near the Frazer Mound and Village site. At the point where it was found, the Tittabawassee River makes a sharp bend and its wearing waters have cut away the bank, which is twenty or thirty feet high and steep. While walking at the foot of this bank early in the spring of 1913, I observed a bone slightly protruding from the sand about three feet from the top; a little digging exposed its mate, the two being the projecting ends of the thigh bones of a human being. These bones, along with those of the pelvis, vertebrae, and arm bones and some of the ribs were extracted by tunneling into the soft sand, but, as time would not permit, further exploration was put off to a more convenient day, which did not come until late summer. Perhaps it will not be out of place to quote from my field notes as written out.

I have a little garden trowel with me, and locating where the skull should supposedly be, I dig. The soft sand is easy digging, but the locust roots are in the way. About two feet down, I come to the back of the skull. I have dug

[4] See F. Dustin, "Some Ancient Indian Village Sites in Saginaw County, Michigan," *Pap. Mich. Acad. Sci., Arts and Letters*, 12 (1929) : 75–93.

too far west. A large root, two or three inches thick, has grown over and pressed upon the skull, breaking it in pieces, although it has bent into a curve over the rounding shell. How like an evil habit adjusting itself to our personality, only later to crush us in its wicked growth!

I now endeavor to loosen the skull from its inclosing roots and sand, using my hands to dig. Close to the skull on its right side, I feel something of a peculiar form. I carefully loosen it from its bed, for it is barely in reach and out of sight. Lo, it is a pipe! A perfect pottery pipe, measuring on the outer curve from top of bowl to end of stem five and one-fourth inches. It is entirely plain.

I now enlarge the hole, digging around the skull so as to remove it without breakage. Every handful of the yellow sand is carefully inspected for other relics. At last it is cleared and careful note is made of its position and condition. The body has been buried facing due east in a reclining position, the head upright, and the shoulders raised. Carefully removing the broken skull, I note that there is not a single tooth remaining in the upper jaw, and that in the lower jaw only the two canine teeth remain, and they were worn nearly if not quite to the gums.

It would thus appear to have been a very old person; to judge from the small mastoid processes, probably a woman. I gather up the pieces of broken skull, some of the vertebral bones, the lower jaw and the loose palatal bone, which has become detached from the skull, and carefully wrap them up. I enlarge the hole and dig a little deeper, but find nothing except two or three potsherds, some bits of chert and a piece of charcoal, probably intrusive, as the soil here is full of these remains.

I do not find in any of McGuire's illustrations of pipes one of this particular type. Figure 111 somewhat resembles it and the peculiar curve of bowl and stem may be seen in Figure 114. The cross-section of the stem is round; I have a number of broken stems of the same type, but in general they are oval with one or two exhibiting a lozenge-shaped cross-section.

It would seem to be a more or less distinct form, but, so far as observed, does not appear to be plentiful enough to permit even a general designation. The material is a closely compacted pottery mixture and the workmanship is good. As it seems to have been unused, it is possible that it was newly made, and for some reason placed with the deceased as a memento or keepsake or token of sorrow. It lay close to the right temple in contact with the skull.

Figure 1 is cone-shaped, but with the small end cut off or truncated. The material is a fine-grained sandstone, one inch in diameter at the top and three quarters at the base, and one and one-half inches high. It is somewhat roughly cut, the marks of the tool

being plainly visible, but it is eminently serviceable; no superfluous labor was expended on it. The bowl resembles in form McGuire's Figure 220, but is stemless, having a hole for the insertion of a wood or reed stem; from the village site from which it was collected I have seen pipes of the Micmac, Atlantic Coast and two or three other types.

I now pass from the exhibit collection to other pipes subsequently collected, and one of them (Fig. 2), picked up on the same field as the one last described, is of similar form and diameter. It is unfinished, and like the other, shows the marks of the tool. It is of fine sandstone, and the hollow in the bowl has been completed, but not the stem hole. It may be doubtful whether it is prehistoric, as it looks as though cut with a metallic blade, although this is not certain, since a sharp chert blade might produce the same appearance, and some of the marks would incline me to think the latter tool was used.

We are informed that pipes of clay were made without tempering material, but in this district it would be exceptional, and an examination of my broken specimens indicates that in general a fine sand was used for that purpose, as the pounded rock employed in pottery-making would be too coarse, and would interfere with making the stem hole. Much more care seems to have been used in making pipes than was exhibited in pottery, although the ornamentation of the latter was superior. A large part of the pottery pipes were without decoration, and much of that which I have observed was crude; it seems quite evident that pipe-making was mostly the work of the men, and that pottery pipes were quite strictly utilitarian, ornament being reserved for the more durable stone. Their forms are often apparently clumsy, but it must be remembered that the material used did not permit much manipulation.

I have a fragment of one pipe made of a red clay and burnt hard (Fig. 5). This pipe was made for a stem and this portion, which has been broken across the bottom of the bowl, is intact and shows a part of the tobacco receptacle. It was neatly molded and smoothed, the stem hole tapering to the bottom of the bowl. There is a raised half-round encircling the stem end. The color is pale

red or salmon pink; on finding it in a muddy place I supposed it to be catlinite from its color and texture, but an examination with the pocket lens shows its true material.

I have described one ovoid pipe; not long ago I picked up another, which in form was a close duplicate (Fig. 6). The material is gray sandstone, fine-grained. The bowl hole is very small, being only a half inch in diameter, but is quite deep; the stem hole is large and tapers as usual. The length is two inches and the diameter one and one-quarter. The top is nearly flat and is ornamented with notches around its outer edge, between which and the stem hole are three incised lines around the bowl. The shape is a duplicate of McGuire's Figure 48.

I now come to a pipe of unique form (Fig. 3), the upper third of which is round; from this to the bottom it is flattened at front and back, with the sides wedge-shaped to the bottom. The wedge at the bottom is cut out to a segment of a circle and the edges of the segment ornamented with narrow notches. Near the top is an incised line, forming a bead or half-round. The material is very fine sandstone. It is neatly made and well finished.

I have a rather crude little coarse sandstone pipe which is of oval cross-section (Fig. 7), of uniform width in line with the stem, but tapering somewhat in its other dimension. The stem hole was drilled too far to the left, giving the pipe an unsymmetrical appearance, but not interfering with its smoking quality, as the artisan bored a little deeper to enlarge one opening and meet the other.

On page 607 of his paper (see Fig. 212) McGuire describes a rectangular stone pipe, and says: "This specimen is sufficiently distinct from other specimens to entitle it to a place by itself." I have two pottery bowls of this type, one collected on village site 2–2, the other from the bed of the Cass River at site 6–4.[5] Both of them are about two inches in height by three quarters of an inch in diameter. The first (Fig. 13) is made of tempered clay and is slightly ornamented by three incised lines around the bowl. The other (Fig. 12) is the most elaborately decorated of any in the collection. Its material seems to be pure clay of a red-yellow tinge.

[5] See pages 90 and 93 of paper cited in note 4.

It had lain in the water so long that the fracture was worn smooth and it is stained as well, so that its texture is uncertain.

There are three V-shaped figures three quarters of an inch long running down to a light line encircling the bowl, forming (if flattened into a plane) three equilateral triangles, with points down, and three others with points up. The former are filled with dots like single quotation marks; the latter by larger round dots. Below the encircling line is a row of crosses.

The general form of this pipe is the most slender and graceful of any pottery or clay pipe I have seen, the stem evidently having been small and resembling McGuire's Figure 212.

The last pipe bowl (Fig. 8) to be described was collected from the Green Point Mounds village site, and is fashioned from a clay stone. It is broken diagonally through the bottom of the bowl, and thus leaves us in doubt as to its form at the base. A portion of its surface shows those peculiar dendrites that are deposited on the chert artifacts found in this particular portion of the flood-plain. I cannot say that they are iron, but incline to that idea, since it does not seem that manganese would be present. There are fragments of chert that closely resemble moss jasper in outward appearance.

This pipe is one and one-eighth inches across the top of the bowl and swells downward one and one-eighth inches to a shoulder, which contracts a quarter of an inch from the greatest diameter of one and one-half inches. The general color is a pale salmon. Between the projecting shoulder and the top the surface has been smoothed, bearing the fine marks of a sandstone rubbing-stone. The small portion remaining below the shoulder is unfinished; it was plainly made by a stone cutting tool. I think, therefore, that this pipe was probably broken before its completion. Both bowl and stem holes were completed, but some accident happened. The missing portion might tell some of the unfinished story.

I have mentioned the usual lack of ornament on pottery pipes. I have a fragment of a bowl (Fig. 17) on which the artistry is so fine, so delicate and so ingenious that I shall not attempt to describe it, although it is formed largely of straight dotted lines very lightly incised into the clay. I should consider, if I had the whole pipe,

INDIAN PIPES

1. Fine sandstone
2. Fine sandstone, unfinished
3. Argillaceous rock
4. Fine sandstone, Micmac
5. Stem, untempered red clay
6. Fine gray sandstone, ovoid
7. Coarse sandstone, oval cross-section
8. Fine clay stone, showing dendrites
9. Pottery bowl, Iroquois type
10. Bowl, pebbly sandstone
11. Catlinite pipe
12. Rectangular pottery bowl
13. Rectangular pottery bowl
14. Pottery, mound type

INDIAN PIPES

15. Clay stone, modified Micmac type
16. Argillaceous rock, small pipe
17. Fragment of pottery bowl
18. Clay stone, unfinished
19. Compact slate, tiny bowl (not described in text)
20. Pottery stem; one side flat, other oval cross-section
21. Pottery stem, lozenge cross-section
22. Pottery stem, round cross-section
23. Pottery stem, oval cross-section

that I possessed a specimen unique in its beauty and fascinating in its associations. It is one of those creations evolved by the human brain that seem to indicate the kinship of the great families of man, and is a reminder of that immortality which, so far as we may know, had no beginning, and so far as we can see, has no ending. Dealing with the Unknown and the Unknowable, we are forced to use figures of speech and make comparisons with those things palpable to our senses, and this bit of pottery, this fragment of a pipe, is a symbol of all that has gone before and all that may come after.

Saginaw, Michigan

THE ARIKARA TRIBAL TEMPLE

MELVIN R. GILMORE

THE Arikara nation is one of a group of racially and linguistically related tribes or nations collectively called the Caddoan stock. Other nations are the Pawnee, Wichita, Waco and Caddo. The remote ancestors of the tribes of Caddoan stock came from the southwest out of Mexico, or from the borders of Mexico. The Caddoan peoples, no doubt, were superior in culture to any other tribes north of Mexico, and it was through them that the science and arts of agriculture were introduced to the ruder tribes which they encountered in their migration toward the northeast. By their influence the conditions of life among these ruder tribes were ameliorated. The architecture of the Caddoan peoples and many other arts of their life, as well as their civil and religious institutions, were borrowed by these other tribes, which acknowledged the superiority of the Caddoan peoples from whom they derived so great benefits.

It is a curious fact that many of the other tribes have received from observers considerable notice and very favorable comment and recognition for the very traits which they have borrowed from their Caddoan teachers and superiors, but the Pawnee, Arikara and other Caddoan peoples have been left unnoticed and almost unknown. The Caddoan nations are conscious of this slight and sensitive to it, as I have had evidence from comments made by some of my Arikara friends.

Of all the Caddoan tribes the Arikara have extended their northward migration the farthest. Their latest movement places them as far north as the parallel of 48 degrees north latitude, on the upper Missouri River in the area now comprised in western North Dakota. In all this northward advance into the regions of shorter and yet shorter growing seasons they have still bravely retained

their agriculture. By careful plant breeding they have succeeded in acclimatizing in the cold north their corn, beans and squashes, plants all originally of tropic habitat. They have also retained their architecture, pottery and other arts, and have taught them to the tribes whom they had as neighbors.

In the aboriginal life of the Arikara tribe there was one type of public building, the Holy Lodge, which we might designate as the tribal temple, because its purpose was to provide a suitable place and a structure wherein the public functions connected with religious rituals might be celebrated. This building was erected at public expense by voluntary contribution of labor by the people in providing and making ready the materials and in erecting it.

The kind of materials, the manner of their preparation, the form of the building, and the method and place of its erection were ritualistically prescribed. The materials used in the construction of the Arikara Holy Lodge and of their dwelling houses likewise were first a framework of timbers, on which pole rafters were laid, next a mat of slender willows, and upon this a thatch of long prairie grass, *Andropogon furcatus*, commonly called bluestem grass, and over all a thick layer of earth.

In August, 1926, I obtained instructions relative to the materials, methods and the ritualistic procedure for the construction and dedication of a Holy Lodge of the Arikara, from Four-rings, a priest or custodian of one of the Sacred Bundles of that nation.

In the northward migration of the Arikara nation during the centuries, along the course of that river which we call the Missouri, but which the Arikara called the Holy, Mysterious, or Wonderful River, whenever the advance caused the abandonment of an old town and the building of another, there was the consideration of providing for the location and erection of a new Holy Lodge.

The dictate of the sacred tradition was that the Holy Lodge should stand in the center of the village and that there should be left all about it an open space in which no dwelling houses should be built; and it also directed that a broad open space or plaza should be left in front of the Holy Lodge to give room for the religious processions and dances and dramatic representation per-

taining to the celebration of the religious festivals of the seasons.

When a Holy Lodge is built it should be so planned and constructed that it will represent to our sight and recall to our minds the natural world in which we live, its beauties and wonders and mysteries. It should make us think of the Chief Above and of Mother Earth, and of all the Aides of the Chief Above which reside in all the four quarters of the world about us. For these reasons the Holy Lodge is built upon a circular ground plan, for when we stand upon the prairie and look about us, we see the earth extended equally far in all directions. And when we look up we see the sky above equally distant from us at all points, like a bright bowl inverted. Therefore the wall and roof of the Holy Lodge shall be of the form to remind us of the sky around and above us.

The main support of the structure shall be four posts to stand in the four quarters of the circle of the lodge. And these four posts are to remind us of the four principal Aides which stand in the four quarters of the world and do the will of the Chief Above in supporting the order and system which we see all about us. Of these Aides the first one stands at the southeast; that is Sunlight, which supplies energy to every living creature. The second is in the southwest, Thunder, the giver of the water of life, without which no creature can exist. The third is in the northwest, Wind, the breath of life, which imparts motion to all things. The fourth is in the northeast, Night, which brings rest and refreshment.

The main posts also have another meaning. They remind us of those creatures which are our friends and companions and helpers in the world. The first of these friends is Vegetation, the earliest of living things in the world. When we look at the southeast post we think of Vegetation in all its beauty over the earth, its useful gifts to mankind and the friendliness it showed to our ancestors in the beginning of the world. The second class of friends includes the tribes of animals, of which the buffalo is chief. When we look at the southwest post we are reminded of the wise ways of these friends of ours, and what they have done for us. The third class includes the creatures of the air. When we look at the northwest post we think of our friends the birds. When we look at the north-

east post we are reminded of the many and great blessings which Mother Corn, our friend and leader, has brought to us, and that she has guided our people from the dim past to the present time and that she will lead us always.

There shall be a fireplace in the exact center of the lodge. Precisely in the apex of the roof, exactly above the fireplace, there shall be a circular opening, which will admit light from the sky and allow the smoke from the fireplace to escape. There shall be a doorway on that side of the lodge which is toward the rising sun, and at the opposite side of the fireplace, against the wall on the side toward the setting sun, there shall be an altar, where the Sacred Bundles shall be opened when mysteries are celebrated and ceremonies are performed.

When a village has been laid out and the approximate location of the Holy Lodge has been determined, the procedure to determine the exact location and precise outline of its ground-plan is as follows. At sunrise a man stands at the approximate center of the proposed site and faces toward the rising sun. Now if we think of a line extended from the point where the man is standing and directed forward to the point where the sun is rising, and backward to the point where the sun goes down at evening, we shall have divided the circle of the earth into halves; one half-circle at the right, and one half-circle at the left. Again, a line drawn through the man's stance and extended to right and left in the directions of his two hands until it meets the circle of the earth will also divide that circle into halves; so that we may think of the circle divided into quarters. Now the man turns his gaze from the line toward the sunrise to a point on the ground midway between that line and the line of his extended right hand. At this midway point he directs his assistant to set a peg in the ground, which marks the place where the southeast main post of the Holy Lodge is to be set. As we have already seen, there are four main posts in the structure, one for each quarter of the circle, and the first of these is at the southeast quarter. When this spot has thus been found and marked by the setting of a peg, the man goes to it and turns so that he faces toward the direction in which his shadow lies (west). He sets his heel against this peg and walks in

this direction, along the line of his shadow, for a distance of six regular steps. At this point a second peg is set to mark the position of the post of the southwest quarter.

The man then returns to the peg which marks the place for the first main post at the southeast. Here he once more sets his heel against the peg as a starting point, but this time he faces toward the north and takes six regular steps, and there another peg is set to mark the place for the main post at the northeast quarter. He sets his heel against this peg and faces toward the direction where his shadow lies (west) and takes six regular steps. Here the fourth peg is set to mark the tentative position of the northwest main post. This position is still tentative for the reason that the four posts must form the corners of a perfect square on the ground. To determine whether the point thus found tentatively is correct, or whether it may be a little too far north or a little too far south, the distance along the west line of the square must now be measured from the peg already set at the southwest quarter to this point at the northwest, equalizing the line at the west side with that already drawn at the east side. When this is done, the true position thus determined for the post for the northwest quarter is marked by the fourth peg.

In this manner the positions of the four main posts have been found and marked. These points mark the corners of a perfect square which is measured by six regular steps from one corner to another on each of the four sides. Now the center of the square must be found, for there is to be the fireplace, and upon it depends the proper position for several other features of the lodge. In order to find the center a thong is tied to the peg which marks the place for the southeast post and stretched to the peg at the northwest and tied. Another thong is stretched from the peg at the northeast to that of the southwest. The point of intersection is the center.

In a circle a certain distance from the center, outside the space inclosed by the four main posts and circumscribing it, there must be twelve shorter posts to support the sloping wall and roof of the lodge. To find the locations for them a peg is set at the point which was found to be the center of the fireplace. To it a thong is tied,

which is then stretched in a straight line to the peg which marks the spot where the southeast main post is to be, and a distance of three steps beyond it. At this point a peg is set to mark the position of the first one of the circle of shorter posts which will support the wall. Then the line is extended again one step in a direct line and another marker is set. This shows where the foot of the slanting wall will rest at the southeast. This last point will be the start of the outside circular line which is the base of the lodge wall.

The method of finding the locations of the twelve outer posts is as follows. A median line is drawn through the lodge from east to west, through the middle of the doorway, the center of the fireplace and the middle of the altar. It will be found that the distance from this line at the midpoint of the doorway to the southeast main post is a measure of six steps. It will be observed also that the arc subtended by this line is one half of the quadrant of the circle; therefore the full quadrant would be measured by twice six, or twelve, steps. Since the number of posts in the circle is twelve there will be three posts in each quadrant of the circle. This will give a space of one third of twelve steps (the measure of the quadrant), or four steps between each two of the outer posts. So to locate the position of these posts a thong as long as the radius of the lodge is attached to the peg which marks the center of the fireplace and extended to the first outer post at the southeast, as already found. From this point the end of the thong is carried four steps in the direction of the sun's movement, that is to the left, and there is marked the location for the second post of the circle, and so on round the circle until the location of each of the twelve outer posts has been marked. When the approximate locations of these posts have been found in each quadrant by this method they are definitely fixed by equalizing the distances between the positions of the posts.

The circular line which is to be the base of the sloping wall of the lodge is found by the use of a long thong attached to the peg which marks the true center of the lodge. The thong is carried in a direct line from this peg to the location of the southeast main post and to that of the first one of the twelve wall posts, which is three steps beyond the main post, and then it is carried directly

on to a point one step farther in a straight line. At this point a peg is set as a marker for the point of beginning of the base of the wall. Then the man walks to the left entirely round the circle of the lodge, back to this place of beginning, setting markers all the way to indicate where this wall circle is to be, at all points equally distant from the true center, as measured by the length of the thong from the center of the place of beginning of the wall.

After the circle has been found for the foot of the sloping wall and also the location of the twelve posts which support the wall, the next thing is to fix the exact location of the two doorposts, one on each side of the doorway, which is on the side of the lodge toward the sunrise. In order exactly to locate the doorposts, the median line of the doorway must first be found, which is done in the following manner. A man again takes in hand the thong by the use of which the circle of the wall was found, and having it still attached to the peg which marks the true center of the lodge, where the fireplace is to be, he takes position so that his shadow at sunrise will fall in line with the peg at the southeast, showing the location for the first of the four main posts. This position is marked. Then he goes, still holding the thong attached to the true center, and takes position so that his shadow at sunrise will fall in line with the peg which marks the position of the northeast main post. Now, with a thong he finds the distance between these two points, and he brings the two ends together. It will be seen that the doubled thong will reach just midway between these two points. The point thus found is exactly in the median line of the doorway. We locate the two doorposts by reference to this median point. A man takes one and one-half steps to the south, and the point in the circular line of the wall which is even with this measure is the location for the south doorpost. Then a distance of one and one-half steps to the north, and that point in the circular line of the wall which is even with this measure is the location for the north doorpost. Thus we have found the location for the two posts of the door, and the width of the door is the measure of three regular steps.

The entrance to the lodge is through a vestibule which is walled and roofed in the same way as the entire lodge. After we have

already found the locations of the two door posts, the distance between, which is three steps, the dimensions of the vestibule are found in the following manner. From the peg which marks the location of the south doorpost a man takes three steps outward, and there sets a peg to mark the location of the post for the south side of the entrance to the vestibule. Likewise, he finds the location of the post for the north side of the entrance by taking three steps from the north doorpost. So we have the floor dimensions of the vestibule, a perfect square, three steps long and three steps wide. Its height is equal to its width and the roof is flat, so that the vestibule is a perfect cube.

The four main posts shall be of seasoned driftwood which has been reclaimed from the channel of the Holy River. They shall have a strong fork at the top to hold the heavy joists or cross-timbers to support the roof. The length of these posts shall be six regular steps and a good arm-reach more, measured from the fork to the base, for the holes into which the posts are set shall be dug one arm-reach in depth.

The four cross-timbers which are to be laid in the forks of the four main posts shall be of new cottonwood, peeled and seasoned. It will be observed that each of the four quadrangular planes bounded by two main posts, a cross-timber and the plane of the floor is a perfect square, whose length is six regular steps and whose height is equal to its length. The space inclosed by the posts is likewise a perfect square whose length and breadth are each a measure of six steps. Furthermore, the plane inclosed by the four cross-timbers is a perfect square equal in its dimensions to the square on the floor inclosed by the four main posts, and these six planes inclose the volume of a perfect cube whose dimensions are equal to six steps.

The twelve shorter posts which stand in a circle to support the top of the sloping wall of the lodge and to help support the roof shall be newly peeled and seasoned cottonwood. They shall be in length three regular steps and one arm-reach more, measured from the fork at the top to the base of the post, for the holes into which they are set shall be dug one arm-reach in depth. The cross-timbers to be laid in the forks of these posts shall also be newly

peeled and seasoned cottonwood. The timbers for the construction of the lodge shall be cut and prepared in the winter previous to the summer in which the lodge is to be built. The rafters to support the roof shall also be newly peeled and seasoned cottonwood. The timbers shall be cut and carried and set up by men; the peeling of the bark is to be done by women.

The rafters must be cut to measure so that the base shall rest securely on the lower joist, while the rafter crosses the upper joist and extends above it to the circumference of the opening for the skylight at the apex of the roof. The method of finding the location of the circumference of the ventilator skylight is as follows. First a ring is made of slender sand-bar willows, rolled and twisted up like a rope in mud and grass. It is made of the same circumference as the ventilator skylight opening is to be. Four long thongs are tied to it at equal distances from one another. These thongs are drawn over the forks of the four main posts in such manner that the ring is suspended over the fireplace in an exactly horizontal position. A measuring pole is now run up from the lower joist until its upper end is in a vertical line with the suspended willow ring, as sighted from a point directly below at the edge of the fireplace. When the length has been thus determined, the pole is marked at the base to be cut off so that it will just rest safely and firmly on the lower joist. This pole will be the measure for cutting all the rafters.

The support of the circular wall of the lodge is of peeled cottonwood slabs, all of equal length and as nearly equal in width as possible. The length of the slabs is found by attaching a thong to the top of one of the wall posts and then stretching it slanting down to the ground at a distance of one step from the base of the post. A pole made of this length is the measuring stick by which are cut all the timbers which are to be split into slabs for the wall. Of old, a wedge for splitting the timbers was made from the heavy thigh bone of the buffalo. The large round head of this bone, which fit into the socket of the hip joint, formed the head of the wedge, and the lower end was made into a wedge shape by grinding on a rough stone. A heavy wooden maul fashioned from a burl of a tree was used to drive the wedge in splitting the timbers.

These slabs were then set in place side by side with their flat split sides inward, their bases on the ground on the circular line marked out for them, and their tops resting against the cross-timbers, or joists, which were laid in the forks of the twelve wall posts. The slabs were thus set closely together all the way round.

The altar shall be at the west side of the lodge, against the wall. The median point of the altar is found by projecting a line from the median point of the doorway, which has already been found in the manner described, through the point in the center of the fireplace, the true center of the lodge, to the wall at the west. At this point a man stands and fully extends both arms, the double reach of which determines the length of the altar from the south front corner to the north front corner. The width of the altar, that is, the distance from its front line back to the base of the lodge wall, is determined by the space required for a man to sit on his knees and heels and have room in front of him to lay out the Sacred Bundle.

The altar is built of puddled clay mixed with short fine grass to temper it. The tempered clay is built up and made smooth with the hands; it is level on top. The height of the altar is the length of the hand from the wrist line to the tip of the middle finger.

There is a post at each of the two front corners of the altar. They are of peeled and seasoned cottonwood; their height is the same as that of the twelve wall posts. The circumference of each altar post shall be exactly the circumference of a circle made by a man in joining the thumbs and middle fingers of both hands. Their tops touch the joist or cross-timber, which rests on the two wall posts of this section of the lodge wall.

During the celebration of mysteries in the Holy Lodge, such as the Mother Corn ceremony, or that of the Holy Cedar Tree, there is placed upon the ground at the base of the south post of the altar a tobacco cutting-board made of the shoulder blade of a buffalo, and on this are laid a pipe and some Arikara tobacco (*Nicotiana quadrivalvis*). At the base of the north post of the altar is placed a buffalo skull facing the fireplace, the doorway and the sunrise.

To set the four main posts the holes are dug to the depth of one

arm-reach. The first post to be set is at the southeast, the second at the southwest, the third at the northwest, and the last at the northeast. When the hole is made ready, a post is carried and placed with the base at the mouth of the hole. Then a pipe is filled and lighted, and smoke offerings are made toward all four quarters, to Mother Earth and to the Chief Above. Then there is placed in the bottom of the hole an offering which consists of a small bit of an enemy scalp, a pinch of Arikara tobacco and a small morsel of food. When all this has been done, the tall heavy post is erected and slid into place. Then the earth which has been removed from the hole is replaced and firmly tamped. Each of the other three main posts is set with similar ceremony.

After the four main posts and the twelve wall posts have been set, the joists are lifted up and laid in place in the forks of the posts, and then the roof timbers or rafters are put in position. The rafters are laid close together. All the timbers are securely bound in their places with rawhide thongs.

After the rafters, or roof timbers, are cut and laid in place and secured, a layer of willow mats is laid on them and bound in place with rawhide. The women go down to the low ground near the river and take their knives and cut the slender sand-bar willows (*Salix fluviatilis*), which grow about the thickness of the thumb. They transport these slender willows in bundles, such as they could carry in their burden-straps, on their backs to the place where the Holy Lodge is in process of building. There the willows are loosely plaited into mats, so that they can be laid on the roof timbers and tied there so as to cover the entire roof surface.

After these operations a thatch of a tall species of grass, *Andropogon furcatus*, is laid over all. When the grass thatch is secured, the whole structure is covered with earth to a sufficient thickness to prevent the rain and snow water from washing it away. For this purpose the men dig the earth with their knives and bone spades, and carry it on their backs in buffalo hides. Thus the earth is banked up firmly against the wall and over the entire roof. When the structure is completed, and the earth covering well settled, the grasses and flowers grow over it in a friendly manner. So our kind Mother Earth, the friendly Vegetation, and the Holy

Lodge are not disunited. We have seen in a previous paper[1] that, when man first came upon earth and was ignorant and bewildered, and knew not yet what was good for his use, and when a Mysterious Voice was heard which gave him welcome into the world of living beings and spoke words of encouragement to him, he learned that it was the voice of Vegetation which thus spoke to him.

The circular fireplace in the true center of the lodge is prepared by digging out all the soil down to the hard subsoil, with bone knives made from buffalo ribs. Both men and women work at preparing the earthen floor. With their knives they cut off at the roots all vegetation, which is gathered up and carried out. The women bring water from the river in water-bags and sprinkle the floor. Then on their knees they even the surface and smooth the floor by hand.

The door of the lodge is made of network, or mat, of sand-bar willows in a frame which is hung from the lintel, to which it is attached by rawhide thongs, so that it can swing inward or outward as one enters or leaves the lodge. The willow matwork is wattled with clay well tempered by puddling and mixing with fine grass. The wattle work of the door is smoothed by hand.

When the structure of the Holy Lodge is finished, the people are called together for its dedication. Two important functionaries on any public occasion are the waiter and the herald. The official station of the waiter is a place near the southeast main post; that of the herald is near the one at the northeast. The master of ceremonies for any function may be any man who is a custodian of Sacred Bundles, of which there were originally twelve, one pertaining to each of the twelve villages of the Arikara nation. The waiter and the herald must be in attendance first and in good time to make everything ready. The waiter must see that fuel is available, that a fire is laid in the fireplace, and that pipes and a supply of Arikara tobacco (*Nicotiana quadrivalvis*) are provided. He must also see that the food for the feast is made ready. He prepares and fills and tends the pipes for all the smoke offerings. He and his assistants serve the food for the feast. The waiters are chosen

[1] Gilmore, M. R., "The Arikara Book of Genesis," *Pap. Mich. Acad. Sci., Arts and Letters*, 12: 95–120.

for their dignity and good standing in the community, since their office is highly honorable.

On the morning of the day of dedication, the herald comes out and sets a ladder against the wall on the north side of the vestibule. This is a cottonwood timber with steps cut in it. By it he mounts to the roof and takes a sitting position there, just above the line between the southeast and the southwest main posts. So sitting, facing toward the sun and down the stream of the Holy River, he addresses all the powers and elements of the earth in the drainage basin of the great river and all living beings in this valley, proclaiming to all that this Holy Lodge is ready to be dedicated. He calls upon the sun and the earth, the rocks and hills and valleys; upon all vegetation, the trees and grass and flowers; upon the waters, the springs and streams and lakes; upon the buffalo and all the animals; upon the winds, the storms and the gentle breezes; upon the birds and other flying creatures; upon the night, the time of rest; and upon Mother Corn, our leader. He begs all these mysterious and wonderful beings to look upon the labor and sacrifice of the people in the building of this Holy Lodge, and to have compassion and give their assistance. He proclaims that today smoke offerings and a feast are to be given and this Holy Lodge is to be consecrated to all the powers of the four quarters of the earth.

Then he turns to the southwest and makes a similar proclamation, and likewise to the northwest and the northeast. Then he descends and goes into the lodge for a while. As preparations in the lodge have progressed, he goes out again and ascends to the roof as before, and again makes proclamation to the four quarters, but now he announces that the door is open, the fire is lighted, the pipe is before the altar and the food is cooked. He bids the people to get ready and to come in. Then he descends, goes back into the lodge and makes smoke offerings toward all the four quarters about the circle of the fireplace.

After this he comes out and ascends upon the roof the third time, and makes the same proclamation in the four quarters except that this time he announces that the mysterious powers are now present in the Holy Lodge. He descends and goes inside and makes smoke offerings again. Then he comes out and ascends

upon the roof the fourth time and announces this time, not to the mysterious powers, but to the people, telling them that all is ready, and bidding them to come in and to bring their children and their aged and feeble.

Now the people hasten to come and seat themselves on the floor of the lodge arranged according to their proper positions in the tribal organization. The Sacred Bundle which is to be used on this occasion lies open upon the altar with all its sacred relics there exposed in proper order, and its custodian, who is the head priest or master of ceremonies, is seated back of it and his four assistants with him, two at his right side and two at his left. The relic pipe from the Sacred Bundle has already been filled with Arikara tobacco and rests in its place on the south side before the altar. On the opposite side before the altar lies a bunch of wild-sage (*Artemisia gnaphalodes*), with its tip toward the altar and butt toward the doorway.

When all things are in readiness, the head priest rises and makes a short oration in which he announces to all the mysterious powers that the Holy Lodge has been built and prepared by the people and that it is now dedicated, and he invokes the blessings of all the mysterious powers that all may be in order within it, as all the world outside is in order.

The waiter lights the pipe and hands it to the priest, who receives it and announces that the time has come to offer smoke, praying to all the powers of the four quarters for their protection of this Holy Lodge. He declares that our own bodies are made an oblation with the smoke of the pipe, and offers the pipe in turn toward all the four quarters, first to the southeast, then the southwest, northwest and northeast, praying the blessing of all these powers. Then he empties the pipe before the altar and sits down again in his place back of the center of the altar.

Then his four assistants receive the pipe in succession and make smoke offerings to the four quarters, beginning with the southeast. Each one, after making the offerings, returns and empties the pipe before the altar and sits down again in his place, and the next one in order performs the act. The first takes his position at the southeast post to make his offering, the second at the southwest, the third

at the northwest, and the fourth at the northeast. Last of all the head priest receives the pipe and carries it round the fireplace, making smoke offerings in all the four quarters, beginning at the southeast main post, and then at each of the other three in turn, ending with the northeast main post. He then empties the pipe formally before the altar, and lays it in its place of rest again at the south side of the space immediately in front of the altar.

After these acts the food for the feast is blessed. For this purpose each of the priests in turn, beginning with the one who represents the southeast quarter, and continuing with those representing the southwest, the northwest and the northeast, takes a pinch of food and places it at the base of each of the four main posts, beginning at the southeast. Finally, the head priest likewise makes these food offerings in the same manner.

When all this has been done, the herald goes out and ascends the roof and proclaims to all the quarters, beginning with the southeast, that Mother Corn has made smoke and food offerings and that now this lodge is consecrated and holy. He announces that those who wish to make a sacrifice may come with their gifts and bring their children that they may be blessed. So the people begin to come up before the altar with gifts, which are usually made by parents in the name of a child. They hand them over to be laid in a heap before the altar at the south side, and present the child to the priest, as the putative giver of the gift. The priest stands before the altar facing toward the doorway, and holding in his hand the bunch of Artemisia before mentioned, turns the child to face the doorway, and with the Artemisia brushes it down the right side, the back, the left side and then the front, praying that it may be cleansed of all fault and kept from error, and may ever walk in the right way of life. The same ceremony is made with each giver of an offering.

When no more gifts are brought to the altar the people all seat themselves again in their places. The food is now announced to be served. The people set their bowls and cups before them and the waiters pass along and distribute the food and drink. After the people have finished eating, but before they have been dismissed, the head priest rises and takes the bunch of Artemisia in

his hand and passes by the north side of the lodge to the side of the fireplace toward the doorway and goes to the southeast main post. He brushes it on its four sides, beginning with the south side. Then he brushes each of the other main posts likewise in their proper order, finishing with the one at the northeast. When he has finished with the four posts he likewise brushes the doorposts, first the one on the south side of the door, then the one on the north. Then he walks back by way of the south side of the lodge to the Holy Place. With the bunch of Artemisia he brushes the altar post which stands on the south side of the altar, then the one on the north. After this is done he likewise brushes the wall posts, first those on the north side of the lodge, beginning with the one nearest the altar; then he crosses the doorway and brushes those on the south side of the lodge, beginning with the post nearest to the door and ending with the one nearest to the altar. After all the twelve wall posts have been brushed with Artemisia he lays down the bunch of Artemisia again before the altar, as it was at first, with the butt toward the doorway.

Then he speaks and says that the people have brought these gifts which are before the altar and have gladly given them to the powers of the earth according to custom. And now since the powers have been pleased with these gifts and with the food and the smoke offerings, they now in turn have given the gifts to him.

Since these goods are now his own personal property, he can dispose of them as he will. Therefore it is his wish to distribute them to those who may have need of them. Then he calls out the names of the persons to whom he intends to give them, the poor, the sick and the old, widows and orphans and other unfortunates. As their names are called the recipients, or their representatives, come and take them away. When the goods have been distributed, the people are dismissed, and they rise and go home.

SUPPLEMENTARY ACCOUNT OF THE CONSTRUCTION OF THE ARIKARA TRIBAL TEMPLE

To the foreging account of the construction of the Arikara tribal temple as told by Four-rings I wish to add as a supplement the substance of some information upon the same subject contributed by an Arikara named Frank Hart. Mr. Hart's information agrees essentially with that given by Four-rings, but he uses different units of mensuration and somewhat different methods of determination of points, angles, lines, curves and planes. He gives equivalent measures, however, so that units of one may be translated into the other. His description of the main timbers and the methods of their placement also differs somewhat from that by the other informant.

Frank Hart, never having attended the white man's schools, speaks no English, but he has sent his children to school so that they may be prepared for their necessary contact with white people, and he has given them good home training. He is a competent farmer and a worthy citizen. He is only a few years past sixty, but he has made research into the ancient ways of his people, and he is conservative of their lore and customs. From long acquaintance with me he understands my purpose and methods, and he is desirous of giving full and cordial coöperation to preserve as accurate and full a record as possible of the ancient culture of the Arikara.

In giving me the following information he took the trouble to go with me to a suitable situation on the prairie and make the measurements and stake out upon the ground the plan of the Sacred Lodge.

He begins with the location of the fireplace, which was the center of the lodge, by which all other parts are oriented. This point was marked by the setting of a peg. The diameter of the fireplace was the measure of the double-arm reach of a man from the finger tips of one hand to the finger tips of the other. To find four points in the circumference of the fireplace he first lay prone with head to the south, the center point under the middle of his chest and arms outstretched east and west. A peg was set at

the finger tips of his left hand to mark the east rim of the fireplace, and a peg at the finger tips of his right hand to mark the west. Then he likewise lay with head to the east and two points

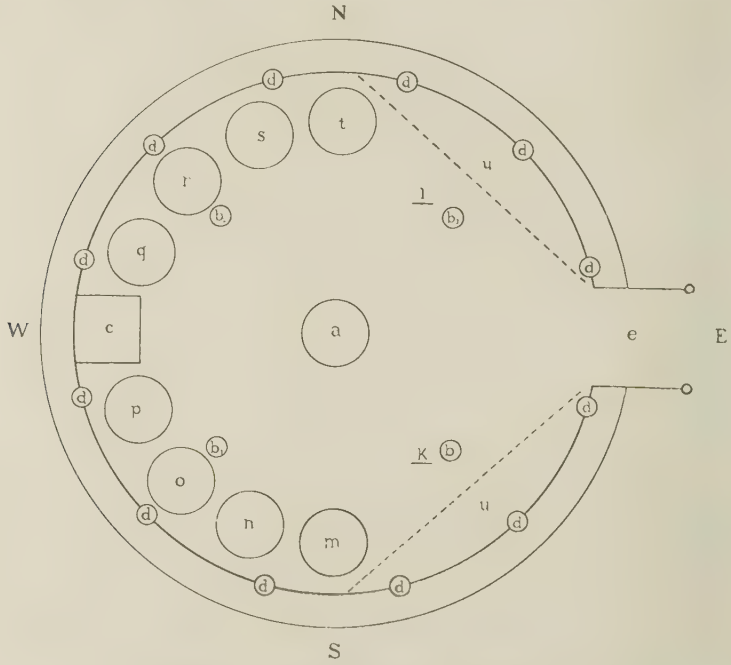


Fig. 1. Diagram of the Arikara Sacred Lodge or tribal temple

a — fireplace
b — southeast pillar
b_1 — southwest pillar
b_2 — northwest pillar
b_3 — northeast pillar
c — altar
d — outer supporting posts
e — entrance
k — seat of the fire chief
l — seat of herald
m — Ghost Society
n — Deer Society
o — Buffalo Society
p — Cormorant Society
q — Duck Society
r — Owl Society
s —Sioux Society
t — Bear Society
u — spectators

in the south and the north were similarly marked. He said that, as we see the figure of the circle dominant in everything, so in the plans of the Sacred Lodge (see Figs. 1–2) the fireplace is circular, the floor of the lodge itself is circular, the posts of the lodge are

circular in cross-section, and the mystic societies sit in circles ranged on both sides of the great circle of the lodge. The circumference of the fireplace was marked out by drawing a circuit with a thong of the same length as the radius, which was the distance from the point first determined to one of the pegs marking the edge of the fireplace.

Next the locations of the four pillars or main posts to uphold the roof were determined. The southeast main post was the first

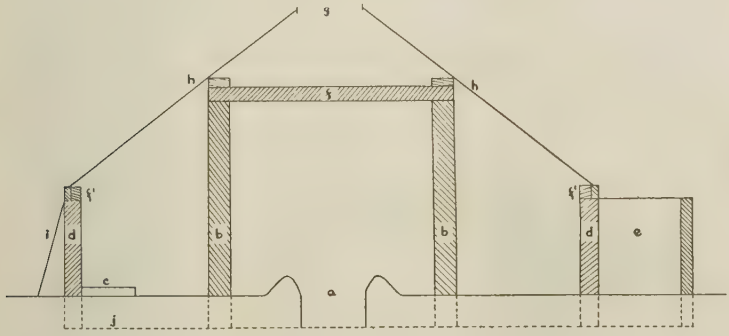


Fig. 2. Elevation of the Arikara tribal temple

a — fireplace
b — large wooden pillars superimposed
c — altar
d — wooden wall posts
e — entrance
f — joists upholding the roof
f' — joists placed on the tops of the outer circle of posts, upholding roof and top of wall
g — skylight in roof
h — rafters supporting the covering of grass and earth
i — slabs used as a foundation for the earth covering below
j — indicates depth at which pillars and posts were set

located, then the southwest, the northwest and the northeast in that order. The position of the main post at the southeast was at a distance of two double-arm reaches (or four steps) from the southeast edge of the fireplace. Similarly the positions of the other three main posts were determined by measurement from their respective arcs of the circumference of the fireplace.

The doorway was in the middle of the east quadrant of the circumference of the lodge. In order to locate it exactly, and also

the altar, which was exactly opposite the doorway and at the west side of the circumference of the lodge, a median line was drawn from east to west through the center of the fireplace. We already have this line through the fireplace, namely, the diameter drawn from the point in the east side of the circumference, through the point marking the center, to that in the west side of the circumference. Now if this line be projected sufficiently far to the east and the west it will run through the middle of the doorway in one projection and the middle of the altar in the other. On the eastward projection of the line, at a distance of three and one-half double-arm reaches (seven steps) a peg is set to mark the middle of the doorway. The width of the doorway is one double-arm reach (or the length of a man), so that we measure one half this distance on the south side of the middle point and we have the location of the south doorpost; a like measure on the north side gives the location of the north doorpost.

Now we must find the location of each of the twelve shorter posts which stand in a circle supporting the sloping wall of the lodge and, together with the four main posts, uphold the roof. The first to be located is that at the southeast. It is found by the use of a thong attached to a peg which marks the center of the fireplace. This thong is extended to the point found in the middle of the doorway. The end of the thong was carried to the left, the direction in which the sun moves, a distance equal to three double-arm reaches, or six steps, from the middle of the doorway. This point will be found to be in alignment with two other points already found, namely the point at the center of the fireplace and the point of location of the southeast main post. Since this distance is one half of the quadrant, the full quadrant will measure twice that distance, or twelve steps. As there are twelve posts in the circle of the lodge there will be one fourth of twelve posts, that is, three posts in each quadrant. Therefore, the distance between these posts will be one third of twelve or four steps. The other posts of the circle are then located by means of the thong which measures the radius of the lodge circle. This is carried to the left, a peg being set at each measure of four steps to mark the locations of all the posts.

After the positions for the twelve posts of the circle were found the position of the altar was located. Mr. Hart walked to the west side of the lodge circle and there laid himself prone upon the ground with his head to the south, his body at right angles to the median line, which was drawn east and west through the lodge circle, and with half his length on the south side and half on the north side. The altar was a square of the measure of a man in each dimension. Thus a peg set at the crown of his head and one at the soles of his feet will mark the limits respectively of the right and left sides of the altar. The distance from the front to the back of the altar was measured by lying prone on the median line of the circle of the lodge with the soles of his feet at the intersection of this line with the lodge circle, and a peg was set in the median line at the crown of his head. Or these measures might be taken by means of the double-arm reach, for a man's double-arm reach is equivalent to the height of his body. The height of the altar was the length of the hand from the tip of the fingers to the wrist joint. The altar was constructed of puddled clay tempered with the blades of bluestem grass (*Andropogon furcatus*).

The posts of the structure, both the four main posts and the twelve outer posts, were of seasoned driftwood from the Missouri River, and the holes in which they were set were dug to a depth of one arm length. The twelve outer posts were of the length of one and one-half double-arm reaches above ground, and had a circumference equal to the circle of a man's two arms joined at the finger tips. The height of the four main posts was the measure of three double-arm reaches above ground, and their circumference was somewhat greater than a man could enclose in both arms. Both the main posts and the outer posts were made flat on top. The joists which rested on the outer posts were cut at the ends in such manner that they fitted together upon the tops of the posts. The joists which rested upon the four main posts were not thus cut to make their ends fit to each other on the tops of the posts, but one pair was laid upon the tops of the posts and the ends of the second pair were laid upon the ends of the first pair. They were hewn in such a way as to lie flat and firm in place. Thus the first

joist was laid with one end resting upon the top of the southeast post and the other end upon the top of the southwest post. Next a joist was similarly laid upon the tops of the northeast and the northwest posts. Then the east joist was laid upon the east ends of the south and north joists as they rested upon the tops of the pillars. Likewise the west joist was laid upon the west ends of the first two.

A vestibule was built at the door of the lodge. The doorway was three steps wide, and the vestibule was extended to an equal distance from the line of the doorway, thus making its floor area a square. The roof of the vestibule was flat and of equal inside area with the floor. These dimensions of length and breadth were equal and of the same measure as the height of the wall posts of the lodge, one and one-half arm reaches; the vestibule formed a cube.

As a support for the earth covering of the sloping wall of the lodge slabs were set up with their tops resting against the joists which were laid upon the tops of the twelve outer posts. These slabs were close-set, with their edges touching. They were set slanting with their bases at a distance of one double-arm reach, i.e. the length of a man, from the bases of the posts.

The timbers of the structure of the lodge were cottonwood. The posts were of cottonwood logs of driftwood from the floods of the Missouri River. The other timbers were of cottonwood, cut, peeled and seasoned. The rafters were laid very close together, their bases set on the lower joists, resting upon the upper joists and their tapering length extending upward toward each other at the apex of the dome, being cut to leave there a circular opening whose circumference was equal to the circumference of the fireplace and directly over it. This opening in the dome of the roof provided ventilation and a place of escape for the smoke from the fireplace. It also gave illumination within the lodge as a skylight.

The rim of this skylight was made by twisting together sandbar willows, together with puddled clay tempered with blades of bluestem grass into a rope-like circular frame of exactly the same circumference as the fireplace. This circular willow and mud

frame were tied to the upper ends of the rafters in a horizontal position precisely over the fireplace.

All the timbers of the structure were bound in place with thongs. Mats were made of sandbar willows woven together with thongs, and these mats were bound upon the rafters over the whole roof to hold the thatch of dry bluestem grass. Over all was laid a thick covering of earth, so that when finished the house resembled a hemispherical earth mound. The men transported in buffalo skins the earth which was used upon the walls and roof, using spades made from shoulder blades of the buffalo for digging. Bluestem grass was used in the roofing because it was found by experience that this species of grass resisted mold, while other species would mold and decay.

The door of the lodge was made of woven sandbar willows and wattled with puddled clay tempered with blades of bluestem grass. This door was suspended from the lintel by rawhide thongs, so that it could be pushed open for entry and exit.

The fireplace was dug to a depth such that the original level of the ground would be at the waist of a man standing within it, and the earth excavated from the fire pit was laid in a circular ridge about it until a man standing within could just see over it. New fire was laid for the first ceremonies in springtime each year. The ashes were not removed, but accumulated from the successive fires of the ceremonies of spring, summer and autumn, when the ceremonies of the harvest home, the thanksgiving for the full ripe harvest of all the crops, concluded the agricultural festivals of the Arikara year. The old ashes were removed the next spring when preparation was made for the spring ceremonies.

During the celebration of the public ceremonies one of the Sacred Bundles of the tribe was laid open upon the altar, and all the others were suspended upon the west wall, back of the altar. The custodian of the Sacred Bundle which was opened was the master of ceremonies. He sat upon the altar back of the open Bundle, with his four assistants, two on each side of him. The eight mystic societies sat in their stations, four on the south side and four on the north side of the lodge, to right and left of the altar, that is, in the southwest and northwest quadrants of the circle

of the lodge. On the south, beginning with the one farthest from the altar, there were the Ghost, the Deer, the Buffalo, and the Cormorant societies. On the north side of the lodge in like order there were the Bear, the Sioux, the Owl and the Duck societies. It is said that the principal societies are the Ghost and the Buffalo, the Bear and the Owl, and that in very ancient times there were only these four, two on each side of the lodge.

Near the southwest main post was the station of the Fire Chief or Chief Waiter. His was an honored and dignified position, and his duties were to tend the fire, see to a supply of fuel, fill and serve the pipes, see to the serving of the food at the feast, receive the gifts and sacrifices for the altar from the donors and assist the priests in other ways as required.

The herald had his station near the northeast pillar. His duties were to make all the public announcements. Most of the time he was seated at this post, but when he made the announcements he mounted upon the roof and called aloud from a position there just above the northeast main post. A short log was placed at this position on the roof for his use as a seat.

Thus was the Sacred Lodge constructed and such were the arrangements for the celebration of the ceremonies in the olden times.

University of Michigan

NOTES ON GYNECOLOGY AND OBSTETRICS OF THE ARIKARA TRIBE OF INDIANS

MELVIN R. GILMORE

THE information here recorded was obtained by me on August 27, 1926, from Štešta-kata, a woman at that time eighty-six years of age. She was considered in her time the best midwife in the Arikara tribe. My interpreter was Mrs. Julia Red-bear, a woman of middle age, but unusually well informed, for a person of her age, upon matters of tribal life. In addition she was quite familiar with the ways of white people.

Special care of the expectant mother and prenatal preparation for the birth of the child begin as soon as a woman knows herself to be pregnant. Young married women are told by older women and midwives to be careful in their diet and exercise. The expectant mother is advised to eat good, wholesome, nourishing food, and, as her time of delivery approaches, to eat sparingly. She is warned that eating too much in the later stages of gestation will cause the baby to grow too large and fat, and that the pains of labor will be difficult and severe.

As to exercise, the mother is advised that she must be active; that hard and varied work will make her strong and fit, and cause delivery to be comparatively easy; but that slothfulness will allow her muscles to become flabby and she will have a hard time in delivery. Though she is informed that it is good for her to take plenty of exercise and keep herself in condition, she is also cautioned to be careful not to strain herself, not to lift heavy loads too quickly, not to submit herself to any jolt, by jumping down from a bank or by slipping and falling; she must take great care against any such accident. It is good for her to be busy every day at her ordinary household duties, to gather and cut wood, to work in the garden, to carry water from the river, to

stretch up under her burden after it is tied up in the burden-strap on her back, to walk up and down banks carrying loads on her back. It is said to be an excellent thing to exercise in all these ways, being careful, however, not to undergo any sudden strain or too prolonged effort.

When a woman's time is about due she lets her woman relatives and the midwife know about what time she expects the birth to occur, so that they can be ready to help her when she needs them. When her pains begin she sends for the doctor and the midwife, and they take care of her and prepare those things which may be needed. They cause her to lie down on her left side with her feet toward the east or southeast, because that is the direction of the flow of the Wonderful River, or Holy River, which is the Arikara name of the river which white people call the Missouri River. Since the Wonderful River and all its main tributaries deliver their waters toward the southeast or east, it seems reasonable to the Arikara people that the delivery in childbirth would be more in accordance with nature, and therefore more easy, if directed toward the same quarter. Her couch is made considerably higher under her head and shoulders, sloping down to the feet. Near the head of the couch there is firmly set in the ground a vertical stake convenient for her to grasp with both hands at once. When they have caused her to recline in this position on the couch they manipulate her abdomen to find out whether the child is in the right position for delivery. If it is in some malposition, as may be determined by gentle pressure of the hands upon the abdomen, the woman is made to turn over on the other side, and to lie for a while in this changed position, while the doctor or midwife presses gently upon the abdomen in such a way as to cause the child to come into the right position. When the pains and movement begin again, the woman is directed to grasp with both hands on the upright support near the head of her couch. At the same time a folded buffalo robe or something of the sort — it might be a pillow — is placed between her knees, in order to keep the way open. She is given a piece of a blanket or some such material to put between her teeth to bite upon in her paroxysm of pain, so that she will not gnash her teeth and bite her tongue.

Of course the child should come head first; that is the best presentation; but if the feet come first it may be allowed to proceed to delivery. If one hand and one foot should come first the position must be corrected, for the child cannot be delivered in such presentation. The hand or foot must be put back. To do this a pillow is placed under the woman's hips, and the midwife takes a piece of soft buffalo hide with the hair on. This she puts over her hand like a mitten with the hair side out. With it she gently pushes back the baby's foot and hand, and the mother's abdomen is gently manipulated to correct the presentation, while at the same time a certain medicine is sprayed upon it. The piece of fur is put over the hand to prevent the possibility of wounding with the fingernails the tender vulva. And for the same reason the Arikara doctors never insert the hand within the vagina for these corrective manipulations, as some white surgeons do. In Arikara practice, in case of any malposition of the child, the helpers lift the woman and gently sway her from side to side while her abdomen is gently manipulated in order to change the child's position.

When delivery seems to be unduly delayed, some of the medicine mentioned before is put upon the top of the woman's head. This medicine is an infusion of the roots of red baneberry (*Actaea rubra*). The midwife also takes some of the medicine into her mouth and sends it forcibly into the mouth of the woman. It is supposed that this will "scare the baby," so that it will quickly move down and be delivered. At the same time the midwife takes in hand a wisp of wild sage (*Artemisia gnaphalodes*) which she has ready. With it she brushes downward on the woman's body in front, both right and left sides, and then down the back, with four sweeping motions from head to feet. It is said that when all this is done the delivery is no longer delayed, and the baby comes quickly.

A woman's suffering is severe in any case, but usually, with good care, she comes through safely and makes good recovery. It sometimes happens, however, that a pregnant woman does not take heed of good advice in regard to right diet and sufficient work and exercise during pregnancy, and so she has a hard time, and may even die. Sometimes accidents occur, as by a fall or other violence,

which may be fatal to the unborn baby, or even to both mother and baby.

In case of postpartum hemorrhage the juice of the chokecherry is given to the patient to drink. Also in such cases the gum which exudes from the chokecherry tree (*Prunus melanocarpa*) is triturated together with the root of *Malva coccinea* and made into an infusion which is given as a drink. In case of laceration of the mother, the Arikara do not resort to surgery. They simply try to keep the wounds clean and allow them to heal naturally.

After delivery the mother must rest and remain quiet for several days, and be careful to be well covered, so that no draft of air may strike her upon the tender parts. She must not stretch; she must not rise too soon; and when she does first sit up part of the time, usually in about four or five days after delivery, or if delivery is quick and easy, even after only two days perhaps, she should sit sidewise on one hip.

During her convalescence the woman must be careful of her diet, avoiding heavy food. For the first three days she must take nothing but a light soup or broth of the consistency of milk. This soup, which is made from flint corn, is easy to digest, and is also good in causing free flow of milk for the baby. She must now be attentive to her diet and general health on the baby's account as well as her own.

After the child is born the midwife cuts off the umbilical cord at a length reaching to the child's knees. The knife used for severing it is made from the long spinal process of a dorsal vertebra of the buffalo. After cutting the cord, she takes it between thumb and finger close up to the navel and presses the blood downward and out. Then she twists up the cord and coils it spirally about the navel and leaves the end turned upward. A ripe puffball is clapped on and bound with a bandage of soft tanned buffalo hide. After three or four days the cord will be dried up and drop off. When the scar has thus formed and healed, the binding is removed. If the child is a boy the father takes the cord, after it dries up and drops off, and carries it away and buries it on the top of some distant and lofty hill. When he does this he lights a pipe and makes a smoke offering and prayer to the Wind that this man-child may

PLATE XXIII

Afterbirth bundle in a thorny bush (*Shepherdia argentea*)

be healthy and vigorous and grow up to be a man strong, brave and courageous. If the child be a girl, the mother takes the cord out to her cornfield. There she digs a little hole with her bone hoe and buries the cord, praying to Mother Corn that this woman-child may grow up to maturity and be quiet, kind, helpful to others, virtuous and hospitable, and thus fulfill the Arikara ideal of useful and happy womanhood.

The placenta, commonly called the afterbirth, is wrapped up in some new pretty calico into a bundle. In ancient times before the coming of traders with white men's manufactured goods, this wrapping was of fine deerskin. A bit of Arikara tobacco (*Nicotiana quadrivalvis*) is wrapped in the bundle, for tobacco is considered an offering most acceptable to all the mysterious powers. Then the wisp of wild sage (*Artemisia gnaphalodes*), which was used in ceremonially brushing the mother at the time the baby was born, is attached securely to the outside of the bundle, which is carried to an out-of-the-way place and fastened in the branches of some species of thorny shrub or tree, such as a wild plum tree (*Prunus americana*), a thorn-apple (*Crataegus chrysocarpa*) or the buffalo-berry (*Shepherdia argentea*). I myself have happened to find two of these bundles, one in a buffalo-berry bush (see Pl. XXIII), and the other in a stout bush of the canyon wild rose (*Rosa woodsii*). When the bundle is fastened to the bush, a pipe is lighted and a smoke offering is made with prayer that disease may not be permitted to attack the child, but may be confined instead to this bundle.

It sometimes happens that in tossing on her couch the patient loosens the covering, so that a draft of air strikes her and causes the blood, which should drain away, to form a clot internally, which brings on after-pains. When this happens, the midwife anoints her hands with buffalo tallow and gently manipulates the abdomen. At the same time the patient is given the infusion of the roots of red baneberry (*Actaea rubra*), which is called in the Arikara language *shkanikatit*. This, with the manual treatment, resolves the clot, which passes down and out, and the patient finds relief from the pain. Then another medicine must be used. *Shkanikatit* is a useful medicine for this, as well as for many other

ailments of women. In case of severe after-pains, when *shkanikatit* alone seems to fail to give relief, a medicine of the following ingredients is used: a dried salamander, the base of a bear's tooth, a bit from the tip of a dried tongue of a bear, and a pinch of the finest sand from the margin of the Wonderful River (the Missouri). To obtain the sand one must go down to the margin of the river when the moon is shining, stoop down and take it up within one's shadow. All these ingredients are to be dried, mixed and pulverized and cooked together. The reasons why the sand must be taken in this particular manner are the belief that the Wonderful River is connected with everything in the life of the Arikara people and the potency which the moon has in the life-process of women. The moon's powerful influence over women may be seen from the menstrual period in every cycle of the moon.

At the time of childbirth care must be given to the breasts. In the case of a young woman with her first baby the midwife moistens the mother's nipples with saliva, so that they may remain small and shapely. If this is not done at first they think that the nipples may grow large and ill-shapen.

In case of inflammation and abscess of the breast a mixture of pulverized roots of red baneberry (*Actaea rubra*) and the application of a poultice made from the spore-mass of a puffball give prompt relief.

If the mother has a scant flow of milk an infusion of the roots of red baneberry is used to bathe the breasts. It is said this treatment will cause a good flow of milk.

According to my informant, in olden times a woman always wore an abdominal band for several days after childbirth until the abdominal muscles recovered tonicity. This was to prevent the sagging of the muscles and resulting deformity. The woman was also advised to eat sparingly for several days.

My informant said she had never known of extra-uterine pregnancy, and also that Arikara doctors never resorted to the Caesarian operation. In fact, Arikara medical teaching and practice in general oppose the use of the knife. Medicaments and physiotherapy are used, but cutting is seldom resorted to in any case.

She stated that in olden times complications of pregnancy were

uncommon. When asked about treatment for placenta praevia, she said she has never known of a case, nor of a case of septicemia. There had not been, to her knowledge, a premature birth in olden times except as the result of an accident. She had not heard of a case of eclampsia either before, during or following childbirth. According to her, women had never been troubled by phlebitis as a complication of pregnancy, but nowadays young married women of the Arikara are sometimes so afflicted, just as many and various other ailments of the white people are now troubling them, since they must live in the same way as the white people do.

Babies prematurely born, as occasionally happened by reason of an accidental fall of the mother, or from some such cause, could sometimes be saved, if they were not born too long before their time. Special care was taken to keep such infants warmly wrapped and secure from drafts.

After the birth of the child it was bathed with warm water and dried. The mouth, nostrils and eyes were washed out with an infusion of the root of red baneberry (*Actaea rubra*). Then a drop of this medicine combined with another medicine, the botanical name of which has not been learned, was placed in the mouth of the infant, on the right side, if a girl, on the left, if a boy. The child was then swathed in a swaddling made from a piece of very old tent cover. Old tent cover was used because the tanned buffalo skin from which it was made became very soft from long use and weathering, and when washed and dried served this purpose well. Soft absorbent packing of cat-tail down was placed next to the skin of the infant inside the swaddling. The swaddling was wrapped round the infant in cylindrical bandage fashion, and not in diaper fashion, according to the methods of white people. An outside covering of buffalo skin with the hair left on came up over the baby's head like a hood.

If a mother had an insufficient flow of milk, an artificial baby food was made in the form of a broth from flint corn and buffalo meat. Sometimes a wet nurse was employed, if one could be had.

At times a baby had a congenital deformity of shortness of the fillet of the tongue, commonly called tongue-tie. My informant

had never seen such a case in the Arikara tribe, but she had heard of one, which was corrected by cutting the fillet; the wound was treated by anointing with warm tallow applied with a wooden spatula.

Babies were suckled until about three years old. When weaned they were first fed on soup made from green corn and buffalo meat, if green corn could be had. When fresh green corn was out of season, dried green corn was used for the purpose.

A congenital deformity of any kind was very rare among the Arikara people, but birthmarks sometimes occurred. It was the popular belief that they were caused by some startling experience of either the father or mother of the child during the first month of the mother's pregnancy. No ill result was feared from such an experience of either parent at a later time than the first month of pregnancy. The Arikara folk belief in regard to birthmarks differs from that of white people, who think that such sinister influence is exerted only through the mother.

No particular attention was given or required in the event of teething. A teething child was given a piece of fat or gristle to gnaw, just as white people use a teething-ring. A child began to walk at about one year of age.

As little girls were growing up and beginning to have questions in their minds about their observations of many things that were mysterious to them, their mothers and aunts and grandmothers tried to satisfy their desires and to give them as well as they could the information which they wished. The grandmother was the most respected member of the family, and she was the principal teacher and preceptor of the girls. As the growing girl's mind grasped some facts and more questions arose, she was gradually taught more about her body, and all its functions, and about her own destined place and responsibilities in society, and what would be expected of her in the tribe. Gradually, through play and household tasks assigned to her, she gained skill in all kinds of arts and crafts pertaining to women's work. She learned to select the seed for next year's planting of the gardens, how to improve and maintain the standard of plant breeding, how inferior stock brings forth inferior progeny. She was taught how to prepare the ground,

plant the seed and cultivate, harvest and store the crops. She attained proficiency in the arts of producing and preparing food, of making and mending clothing, of caring for children, of attending to all household duties. She was trained to be diligent, industrious and economical. She was educated in the Arikara code of ethics and morals and disciplined in good manners.

Grandmothers used to say to their young granddaughters, "My granddaughter, you will some day have your own home and its responsibilities. You must learn now how to care for your home, to keep it in order, to prepare good and proper food for your household, to make your people comfortable and happy. You should know how to take care of your husband and your house, to be hospitable to guests and to strangers, and to be helpful and kind to your neighbors. Be dutiful to your own husband, be careful of his honor and proud of his achievements; make him comfortable and content at home. Let all other men alone. If you look after your husband's comfort, guard his interests and show hospitality to his guests, you will do honor to his name and he will cherish you, and you will be happy with him.

"Be kind to old people. Help the needy. Be agreeable to your neighbors. Be not a tale-bearer. Be diligent in all the work of your household and your garden. Love your corn and tend it with care. Be not lazy; be not a borrower nor a beggar. Attend to your own affairs; work well in your garden and have wherewith to provide for all the wants of your own household, and to help others who may be in need." Such was the admonition given to young girls of the Arikara people in former times.

Arikara girls usually had their first menses at about fourteen years of age, sometimes later. My informant said her first menses occurred when she was sixteen years old. Girls were instructed beforehand by their mothers or grandmothers, so that this event did not take them unaware or unprepared. During menstrual periods it was the custom for a woman to dwell in a small lodge apart from the family. As little girls saw this occurring every month to all the women of their acquaintance, to their mother until the time of her menopause, and to their older sisters, they came to know of this recurrent event in the life of women. It was

explained to them that when they should arrive at a certain age, they should expect this to occur to them also.

During the four-day menstrual period a woman took an infusion of the leaves of the big wild-sage (*Artemisia gnaphalodes*) or of the roots of the little wild-sage (*Artemisia frigida*), which is a bitter tonic and is considered very useful in assisting the physiologic functions. As they did not have cotton fabrics in the olden times, before contact with white people, the Arikara women used for menstrual napkins pieces of old smoke-flaps saved from worn-out covers of buffalo skin, a material which, as we have noted, was soft and pliable from long weathering and flapping in the wind. These softened and porous old smoke-flaps were washed like cloth and cut into suitable pieces for their new use as sanitary material.

When a girl arrived at puberty her family would make a ceremony for her, which marked in a public manner the girl's arrival at womanhood and the new status she was now to have in the tribe. To conduct the ceremony some highly respected old man or woman of the community was invited to officiate. A priest was asked to open in the Sacred Lodge the Sacred Bundle of which he was custodian. When it was opened the pipe was filled and lighted, and with it smoke offerings were made to the Higher Powers on behalf of the girl, and she was presented before the altar. There the clothing she was wearing was removed, and she was clothed only in a girdle, like a short skirt or apron, and at this time she was painted all over with white clay.

Then the old person who had been selected by her parents for this purpose addressed a homily to her. It would be composed somewhat as follows: "You now stand in a new relation to the tribe. You are no longer a child. You are now a woman, and you have a woman's responsibilities, the responsibilities of wifehood and motherhood. I must warn you that, now that you are a woman, you will meet new and strong temptations against which you must carefully guard yourself, and which you must overcome. You must preserve your honor and purity. A good woman is quiet, peaceable, kind to all children, to all unfortunate persons and to the old. A good woman is a good wife and mother, dutiful to her husband and careful of the upbringing of her children. A

good woman willingly and earnestly undertakes the labors and responsibilities which fall to a wife and mother; and the honors which pertain to her position as such will be hers."

When the homily was finished the girl was brushed down the front, right side, back and left side with a wisp of sweetgrass. Then she was clothed in new clothing in place of the old which had been removed. It was believed that the spirit of sweetgrass is attractive to all spiritual influences for good, especially all those benignant influences which make for kindliness, peace, benevolence and intercession. The brushing of the girl with sweetgrass was an invocation of all good Powers in the four quarters of the universe to watch and guard and aid her. Clothing her in new apparel was symbolic of the new life, the new relationships to the tribe, and the new responsibilities she now bore.

When the girl had been attired in her new clothing in place of the old which had been discarded, and had been symbolically brushed with the wisp of sweetgrass, the priest prayed for her that she might be ever blessed with the favor of the Higher Powers, that she might be kept in the right way of life, that she might be an honored mother in the tribe, and that she would ever love and serve Mother Corn and be faithful to her teachings. At the conclusion of this prayer she was conducted back to her place in the group by her mother, an act that signifies her full induction into the new station she would occupy as a woman, now no longer a child.

Like all other public functions this ceremony is terminated by a feast. The food is brought in and the priest blesses the repast by making offerings of bits of food to all the Powers. After the blessing the people set out their dishes before them as they sit in their places in the lodge, and the waiters serve them with food. They begin to eat when the signal is given that all have been served. After the meal is finished the pipe is filled and lighted, and the usual smoke offerings are made to the Powers in the four quarters of the world, to Mother Earth and the Chief Above in the heaven. This act concludes the ceremony, the people are dismissed, and they rise and go home.

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VEGETAL REMAINS OF THE OZARK BLUFF-DWELLER CULTURE

MELVIN R. GILMORE

DURING the spring and summer of 1922 and the early part of 1923 an archaeological exploring expedition from the Museum of the American Indian, New York, was in operation under the leadership of Mr. Mark Raymond Harrington in the northwest part of Arkansas and the southwest part of Missouri in the Ozark Mountains. There Mr. Harrington discovered remains of a pre-Columbian culture. In the course of his operations he found below these remains a stratum of a still older culture. This older culture was designated by him as the Bluff-Dweller culture, from the nature of the habitations, which are in shelters under the overhanging ledges of limestone in the precipitous bluffs overlooking the gorges of the rivers in that region.

The explorations were conducted on the upper course of the White River in Carrol and Benton counties in Arkansas, and on the Elk River in McDonald County, in the southwest corner of Missouri. No report has yet been published of the findings of this expedition, except a preliminary one by Mr. Harrington in *Indian Notes*, Vol. I, No. 1, and in the *American Anthropologist*, Vol. 26, No. 1.

Happily it fell to my lot as ethnobotanist to undertake the very trying and exacting, but intensely fascinating, task of examining all the vegetal material of these remains of the Ozark Bluff-Dweller culture for the purpose of determining the species of plants represented and interpreting the uses which they served in the life of that people. It was surprising to find that, even though the rock-shelters are situated in a region of fairly humid climate, their physical structure is such that the interiors of most of them are extremely dry, not having a trace of dampness, so that organic remains have been perfectly preserved.

No means have been found to date definitely the period of the Bluff-Dweller culture of the Ozark region, but many of its features are so similar to corresponding ones in the Basket-Maker culture of southern Utah, which we know to be much older than the earliest stage of the Pueblo culture, that it may have been contemporaneous with it. However that may be, at all events the Bluff-Dwellers of the Ozark did not possess the bow. Their only engine for propulsion of pointed missiles was the *atlatl*, or "throwing stick," for the hurling of stone-pointed javelins or darts.

I think we all like to know what other folk are doing and what they have done; how they live, what they eat, what they wear, what occupations they have, what work and recreations. And one who is acquainted with the plant world is interested to know the inter-relations between the human population and the plant population of a region. By the light of what I had already learned from informants among living Indians concerning the uses of native plants by Indians of late historic time, I was enabled to interpret the uses of the objects of vegetal origin which were left by the prehistoric Ozark Bluff-Dweller Indians. So, identifying the species of trees, shrubs, vines, grasses, herbaceous plants and fungi, which were recognizable by their wood, bark, leaves, roots, seeds and fragments, some of these parts or products in storage places, such as food supplies, or in manufactured objects, or in worn and broken waste materials in rubbish heaps; and being able to interpret their processes and uses, I was able to visualize, at least dimly through the avenue of the centuries, the flora of the Ozark Mountains as it was in that time, and the life and activities of the people who lived there in those far-away years, in their relation to that flora. By the objects which they left, by contemplating the species of trees and other plants from which the objects were derived and considering their uses, I was able mentally to see the annual march of the seasons, the burgeoning of leaves and flowers of the forests and the return of green spangled with bright blossoms of the wild flowers on the grasslands, followed in regular order by the ripening of the fruits and nuts with the passing of the summers. And with all this in mind I was able to picture the seasonal activities of the people, at their planting and tending of their crops, their harvesting

and storing of them; their quest of food, their gathering of the native fruits and nuts; their home manufacture of clothing, tools, implements and utensils. One could picture the babies in their cradles, the children at play. It is only by knowledge of the arts and customs of living tribes that we can form a conception of the habits and manner of life of their ancestors or of the people of other tribes who were before them.

We know that the Ozark Bluff-Dwellers were farmers. We have no traces of their fields, which no doubt were cultivated in the alluvial soil of the river valleys, but abundant evidence of those fields is found in the products remaining in their places of habitation, and in the tools with which they were worked, and bags of select seed put away against the next planting time.

In their stored provisions were found supplies of corn of a number of varieties in each of several types, several varieties of garden beans, squashes and pumpkins, by which I mean varieties of both the winter squash (the Hubbard squash type), *Cucurbita maxima*, and the summer squash type, *Cucurbita pepo* (see Pl. XXIV B). They also cultivated egg gourds (see Pl. XXIV A), large and small, which they used as vessels of various kinds, cups, ladles, jugs and bottles, bowls and so forth. They also raised sunflowers for their seeds, which were used as a food supplying a rich vegetable oil. Of these they had several varieties as large as any that are grown at the present time, the seeds measuring one-half inch in length.

Like all good and prudent farmers those ancient farmers of the Ozarks put away carefully in woven bags a good supply of specially selected seed stock of all their crop plants for the next spring's planting.

But besides the well-known staple crops of corn, beans, squashes, pumpkins and sunflowers, which were cultivated by those ancient people and by many other tribes of Indians from that time down to the present, there is evidence that the ancient Ozark Bluff-Dwellers also had certain other species of plants not cultivated at the present time. The ground for this statement lies in the fact that supplies of the seed of these other species of plants were carefully put away together with the selected seed of corn, beans, sunflowers, squashes and pumpkins.

Among the other species of plants which appear to have been cultivated by those ancient farmers were a species of Chenopodium, goosefoot or lamb's-quarters, very closely related to *Chenopodium nuttalliae* Safford, rough pigweed (*Amaranthus sp.*), giant ragweed (*Ambrosia trifida* L.), burweed marshelder (*Iva xanthifolia* (Fresen.) Nutt.) and Carolina canary grass (*Phalaris caroliniana* Walt.).

The lamb's-quarters, Chenopodium, no doubt was used by the ancient Bluff-Dwellers as a pot-herb, or "greens," just as it is by white people at the present day. The rough pigweed, Amaranthus, which every farmer now knows as a garden weed, was probably cultivated for the use of its seed as a food grain, just as it was in ancient Peru and other parts of tropical America, where it is still cultivated for the same purpose at the present time.

The giant ragweed, *Ambrosia trifida*, was probably cultivated for its seed to be used as food. The most significant fact, besides its abundance in the Bluff-Dweller remains, is the uniformly very large size of its seeds and their uniformly light color. These facts would seem to indicate the cultivation, selection of stock and improvement of this plant; for the seeds found in the remains were uniformly four or five times the size of any which can be found growing at the present time without cultivation as weeds. Also, besides the much smaller size of seeds of this species, as they are to be found at the present time, they are variegated in color, many being quite dark, almost black instead of the uniformly light color of those found in Bluff-Dweller remains. The seeds of *Ambrosia trifida* were probably used for food, but the plant may have been employed as the source of a stain or dyestuff, a use to which it was put in its uncultivated form by Indians of historic times, as I learned in a curious and incidental manner. Talking with an Arikara informant I told of my finding seeds of this plant among the Bluff-Dweller remains. The Arikara said: "I do not know how this plant may have served those ancient people, but now I will tell you a use which our people made of it. If you crush the flower heads in your hand you will see that it makes a red stain." He suited action to words and demonstrated the fact. Then he said: "Our people formerly employed the blossoms of this plant to make a red dye." Another Arikara informed me that formerly in snaring

birds the seeds of this plant were used for bait. Afterward, an Omaha to whom I was speaking of this plant said: "Well, I do not know what others may have done with this plant, but our people used to make beautiful red stain from its flowering tops."

What utility *Iva xanthifolia* had for the Ozark Bluff-Dwellers is now a problem. For an experiment to explore its possibilities I gathered a quantity of seeds from this plant and found that they give off a rather agreeable odor. Possibly the ancient people of the Ozarks made a perfume of them. Another suggestion is that the plant served some medicinal purpose. This suggestion is supported by the statement of an Arikara that he had heard that some southern Indians do use it medicinally. Besides these considerations, which appear to indicate that *Iva xanthifolia*, *Ambrosia trifida*, a species of Chenopodium and a species of Amaranthus were cultivated by the Bluff-Dwellers, there is another indication in the habits and behavior of all these species which gives the impression that they have been accustomed to domestication. All of them seem to have become attached to man and to prefer to dwell near human habitations, in ground which has undergone disturbance due to human occupation.

Du Pratz, *Histoire de la Louisiana*, 3:9, makes mention of two species of plants the seeds of which were used for food by the native people under his observation. He says: "They also make food of two grains, one of which is called *choupichil*, which they cultivate without difficulty, and the other is the *widlogouill*, which grows naturally and without any cultivation. These are two kinds of millet which they hull in the same way as rice." By "rice" he means wild rice, *Zizania aquatica*.

Small sheaves of the heads of Carolina canary-grass (*Phalaris caroliniana;* see Pl. XXV, Fig. 1) were found put away with the sheaves of the seed heads of Chenopodium, Amaranthus, Ambrosia and Iva. No doubt the grain of Phalaris was one of their cereal foods, as were also the seeds of the great southern cane (*Arundinaria macrosperma*). Some leaves of this cane were found, but no seeds. The cane does not bear fruit every year, but when a crop was borne it was eagerly harvested and used for food by southern tribes, as was observed by some of the earliest French ex-

plorers. One of these, Pénicaut, writing of the Pascagoula tribe, says: "Their bread is of corn and a grain which comes from the canes." [1]

Great quantities of acorns of several species of oak native to the Ozarks were found stored away for food. The Ozark Bluff-Dwellers also made abundant use of hickory nuts, black walnuts, hazelnuts, pecans and chinquapins. There was ample evidence of fondness for all the species of wild grapes of that region and of all the other wild fruits.

Twine and cordage were made from fibers of a number of native plants. We find employed for this purpose the bast fibers of basswood (*Tilia americana*), Indian hemp (*Apocynum cannabinum*) and strips of bark of leatherwood (*Dirca palustris*). Other fibers found in cordage and weaving were *Yucca arkansana*, *Ulmus fulva* Michx. (slippery elm), and one which appeared to be from bast of *Toxylon pomiferum* Raf. (bodark or Osage orange).

The Bluff-Dwellers made much use of the bluestem grass (*Andropogon furcatus* Muhl.). Temporary ropes for binding and carrying bundles and bales of bulky commodities in autumn and winter were twisted from its ripened blades. For this purpose a handful of the fallen basal blades lying at the base of the stalks in a loose mat all over the ground on the prairie was grasped and twisted, lifted slightly and twisted again, until a rope of the desired length was formed; this method is well known to every farmer who makes by hand a temporary rope from a straw pile or haystack.

From this grass rope the Bluff-Dwellers also made large net bags for carrying home the garden produce or other commodities when a carrying basket did not happen to be at hand. This grass was also used to make sandals for warm weather and insoles and warm padding for moccasins in cold weather. There was found a pair of overshoes woven from twisted stems of bluestem grass. Dried Ozark mud was still clinging to them, just as it was the last time their owner wore them when he came in weary from work some late winter day so long ago.

Another curious use of bluestem grass was for the making of

[1] Margry, *Découvertes*, 4: 454–455, 1880. Quoted by Swanton, *Bureau of American Ethnology*, Bull. 43, p. 303.

breech-clouts. For this purpose a wisp of the longest of the basal blades was taken and a knot tied at the lower end of the wisp. A girdle of cords was worn; in putting it on the knot on the end of the wisp was tucked under the girdle at the back, just over the lumbar vertebrae. Then the wisp was passed between the thighs and up in front under the girdle and the distal end was draped over it in front.

A great number of these grass breech-clouts were found which had been discarded when worn out. They were a puzzling problem to the archaeologist until a mummified body of a man was found with one of them in place.

Mats and bags were woven from bulrushes (*Scirpus validus* Vahl.). Strips of bark of leatherwood (*Dirca palustris* L.) were used as thongs and strings for tying all sorts of bundles and as bails for baskets and so forth.

The scutch cane, or small cane (*Arundinaria tecta* (Walt.) Muhl.), met very many needs. The full canes of proper length were employed as the shafts of javelins. Splints of this cane were used for baskets of all kinds and sizes. In manufacturing them the canes were first split into four quarters, and then a thin splint was removed from the back of each quartering splint. The thin, narrow splints were used for all the finer basketry and small baskets. The larger, coarser splints remaining after their removal were serviceable for making the large baskets for gathering and transporting supplies. Cradleboards were made with a framework of bent canes and with splints woven across in a manner similar to the weaving of baskets.

As the Indians of the northeastern woodland region, where the birch abounds, made vessels and utensils of various kinds from birch bark, so the Ozark Bluff-Dwellers used the bark of the elm tree, which was the best bark for the purpose growing in the region of the Ozarks.

There were found strings of beautiful, pearly white beads, made from the seeds of Ozark gromwell (*Onosmodium subsetosum*). This is a plant of the Borage family which grows on the prairies. Its seeds are nutlets about three thirty-seconds of an inch in length, of ovoid form, hard, white and lustrous. So when I found

these beads, I could visualize a young Bluff-Dweller moving about busily engaged in gathering the ripened seeds of this plant on the grasslands of the Ozarks where it grows, with the August sun blazing above him and the prairie grass rustling about his feet. And then I could picture him as he sat in the shade of a tree manufacturing these tiny beads, holding them in a split stick, as in a vise, while the hard shell of the seed was ground away at each end by rubbing on a stone, thus making perforations possible for stringing.

It is remarkable that no specimens were found derived from certain species of plants which one would naturally expect to discover among the remains of any people of that region. It is notable that there were no wild cherry or wild plum pits, with the exception of a single bead made from a pit of a Chickasaw plum, nor seeds of the native apple, the Iowa crab-apple. No specimens were found of the roots of *Echinacea angustifolia*, although it is native to the region, and is most highly prized for medicinal uses among various tribes of Indians of historic times. Garden beans were abundant in the food stores, but there were not found any of the native wild ground beans, *Falcata comosa*, which were used to so great an extent by all tribes of Indians residing in the range of this plant in historic times. It is thus probable that they were also used by the prehistoric Bluff-Dwellers, yet since they are a commodity which was not kept in storage by the people, but was brought home for immediate consumption, there would be small chance that any stray specimens might be found in the dwellings, even though they were used.

Another species of plant which was highly prized for food by Indians of historic times over an extended area of eastern North America from the Gulf of Mexico to the Great Lakes and the upper Mississippi River is the American lotus, *Nulumbo lutea*. Because of the high esteem in which it was held throughout the extent of its range by Indians of historic times, it would be expected that, if the Bluff-Dwellers had been acquainted with it, they also would have known its desirability for food, and that seeds and dried rootstocks of it would remain among their food stores. But none were found.

There is good reason to believe that the present extended range

of this plant to the northward from its original southern habitat has been accelerated and largely accomplished by human agency, that is, the tribes probably have disseminated the lotus successively farther and farther north until it has reached its northward limit of endurance. Thus, although the present range of the species extends far beyond the Ozarks, in the time when the Bluff-Dwellers lived it may not have been there.

Another plant, which, though not cultivated, has been dispersed widely and which has had its range greatly extended by human agency in ancient times, is the sweet-flag, *Acorus calamus*. That is my opinion from the conjunction of the phytogeographical and ethnobotanical lines of evidence pertinent to this plant. And there was abundant evidence of sweet-flag throughout the explorations of Bluff-Dweller remains. So it would seem that at whatever distant time these people lived in the Ozarks sweet-flag had already been brought by successive stations from its primeval area and had become established as far west as the Ozarks, and was greatly valued and much used by the Bluff-Dwellers.

A puzzling fact is the presence of great quantities of remains of *Tripsacum dactyloides* L. in the Bluff-Dweller habitations. The seeds undoubtedly would be good for food, but they are so deeply imbedded in the hard, tough rachis that one cannot see how the Indians could have separated them. The hulls might possibly have been cracked by pounding in a mortar and then winnowed out.

In view of the prevalence and very widespread use of tobacco among the tribes not only of tropical America, but also of North America, it was quite surprising to find absolutely no trace of tobacco, neither stems, nor leaves nor seeds in any of the Bluff-Dweller remains. This would seem to indicate that at the time when the Bluff-Dwellers lived in the Ozarks tobacco had not been brought so far from its original habitat in the tropics, although the Bluff-Dwellers possessed several other cultivated plants from the tropics, namely, corn, beans, squashes, pumpkins and gourds. Since the cultivation of beans and squashes has always and everywhere been inseparably connected with the corn complex, it would appear that the cultivation and use of tobacco are not necessarily

part of that ancient complex. At all events, the fact is that no trace of tobacco was found in the Bluff-Dweller remains.

I append a taxonomic list by families of species found in Bluff-Dweller remains. I have given the catalogue numbers of most specimens, as they are listed in the Museum of the American Indian, Heye Foundation. I desire to acknowledge the assistance of Dr. W. E. Safford, Dr. Sidney F. Blake, Dr. Lister H. Dewey, Mr. Oliver M. Freeman, Dr. A. S. Hitchcock and Dr. James R. Weir, all of the Bureau of Plant Industry, of the U. S. Department of Agriculture, in specific identification of numerous specimens.

A large discoid fungus was found in one of these rock-shelters. It proved to be *Daedalea quercina* (Linn.) F. R. This species was probably used as tinder for holding and carrying fire to places at some distance, just as in historic times this and several similar species of fungi have been used by people of various tribes of Indians. $\frac{11}{8990}$.

A wisp of moss, *Anomodon rostratus* (Hedw.) Schp., was found, but there was no indication to suggest what its use might have been. This is a species which is common east of the Mississippi River, and as far south as Florida. $\frac{11}{6552}$.

A number of specimens of *Equisetum pratense* and of other species were found. These plants when dry were probably used just as modern Indians use them, namely, for scouring and polishing purposes. They have also been used in similar manner by white people, and this use is indicated by one of their popular names, which is "scouring rush." $\frac{11}{5850}$, $\frac{11}{5782}$.

We shall list the species of seed-bearing plants in taxonomic order by families from the lower to the higher. In most cases each species is represented by numerous specimens. We need not indicate every specimen in the collections by museum number, for there would be too many. Of other species there may have been found but one, or at most a few specimens. Some individual specimens may be of particular interest and significance; to facilitate reference to particular specimens in the museum their numbers will be given.

Pinaceae

Pinus echinata Mill. Yellow pine. $\frac{1}{7}\frac{1}{5}\frac{1}{5}\frac{1}{7}$.
Pinus taeda L. Loblolly pine. $\frac{1}{6}\frac{1}{5}\frac{1}{9}\frac{1}{3}$.

No doubt the wood of pine species was used for various purposes, and probably their resin had uses; probably also the leaves were used as historic Indians have used them, for incense and for fragrance. The loblolly pine has very long leaves, or "needles," as they are called, and a piece of cord was found twisted from the leaves of this species.

Juniperus virginiana. L. Red cedar. $\frac{1}{6}\frac{1}{2}\frac{1}{1}\frac{1}{8}$, $\frac{1}{7}\frac{1}{3}\frac{1}{8}\frac{1}{2}$.

Mystic properties are attributed to the red cedar and reverence is paid to it by many tribes of historic times; its leaves and twigs are used as incense in religious ritual. Apparently it was held in reverence by the Bluff-Dwellers also, and used by them for incense and in funerary ceremonies. Red cedar twigs were found in graves, and cedar poles were laid over the graves in crisscross fashion, with stones upon these on top of the grave.

Typhaceae

Typha latifolia L. Cat-tail.

Parts and fragments of plants were sufficiently abundant in the rock-shelters, and it probably was used in the several ways customary among Indians of historic times.

Gramineae

Tripsacum dactyloides L. Gama grass.
Zea mays L. Indian corn. Maize.

Relics of Indian corn were abundant at all the sites. These remains consisted of shelled corn in bags, cobs from which the grains had been shelled, some ears not shelled, husks and other fragments. A number of varieties of three or four types were found. These types are flour corn, dent corn, flint corn, and what appears to be popcorn, or else a very small variety of flint corn. There are many cobs with eight, ten, twelve and fourteen rows of grains. There

were loose grains of dent corn which measured three eighths of an inch in length and three sixteenths of an inch thick and three eighths of an inch wide. One ear of red cob yellow dent corn eight and one-half inches in length has twelve rows of grains, which are seven sixteenths of an inch in length and width and three sixteenths in thickness. It is well known that our stock of dent corn, which is the type cultivated as the chief grain of the great American corn belt states, was first obtained in early Colonial times from the Indians of Virginia. But the finds of dent corn in the Bluff-Dweller remains are the only specimens of the dent type which have come directly from the hands of the aboriginal cultivators to white men's hands in the last three centuries. $\frac{12}{306}$. (See Pl. XXV, Fig. 2.)

Andropogon furcatus Muhl. Big bluestem grass.

Many specimens of various objects of many different uses were made from this species of grass. There were found pieces of temporary rope twisted from the long lower blades of this grass, temporary netted bags for carrying commodities, sandals, insoles for moccasins, and over-moccasins for winter wear.

Andropogon scoparius Michx. Little bluestem.
Sorghastrum avenaceum (Michx.) Nash. Indian grass. $\frac{11}{7310}$.

There was found a fragment of a mat made from a grass which appeared to be of this species.

Phalaris caroliniana Walt. (see Pl. XXV, Fig. 1). Carolina canary grass. $\frac{11}{6557}$, $\frac{11}{6570a}$.

Many sheaves of the heads of this grass were carefully put away in a manner suggesting that it was valued. In all probability its value was in the use of its seeds as a grain for a food.

Elymus arkansanus Scribn. and Ball. Slender wild rye.
Arundinaria macrosperma Michx. Giant cane. $\frac{11}{5976}$.

No doubt the Bluff-Dwellers used its seed for food, as did all the Indians in the range of the species in historic times. It is most likely that the canes had their uses in manufactures.

Arundinaria tecta (Walt.) Muhl. Scutch cane.

The Bluff-Dwellers used splints of this species for making baskets and cradles, the canes for shafts of darts and for many and various other uses.

Cyperaceae

Scirpus validus Vahl. Great bulrush. Mat rush. $\frac{12}{268}$.

Bulrushes were used for making mats and bags.

Araceae

Acorus calamus L. Calamus sweet-flag. $\frac{11}{6249}$.

Rhizomes of calamus were conspicuously abundant in all the sites. It was evidently highly valued by the ancient Bluff-Dwellers, as among Indians of historic times, for medicinal and ritualistic uses. One of the specimens was charred on the surface side, as it lay originally in position of growth, as if in a time of drought fire had run over the marsh where it grew, burning away the leaves and scorching the exposed side of the rhizome.

Liliaceae

Allium sp. Probably *Allium mutabile* Michx. Wild onion.

No doubt used for green salad, as it was by Indians of historic times.

Yucca sp. Spanish bayonet. Yucca.

Yucca fibers were used for weaving of sandals and other articles. There is no way to determine whether the Bluff-Dwellers used the root for washing, as did Indians of historic time.

Salicaceae

Populus deltoides Marsh. Necklace poplar. Cottonwood.

Many specimens were found. The wood was used for various purposes. Bundles of the dry, shredded inner bark apparently were prepared for use as tinder. Numerous curious knots of twigs with the leaves on were found. These may have been used in play

by children. Specimen $\frac{10}{66}$ is a bundle of cottonwood leaves. The presence of a human hair and the appearance of care in making the bundle and securing with a grass string at first suggested a charm bundle, but probing disclosed nothing within. It may have been merely an object of children's play.

Salix nigra Marsh. Black willow.

A bundle of leaves of this species was found. $\frac{11}{8838}$.

JUGLANDACEAE

Juglans nigra L. Black walnut.

The nuts were used for food; probably the hulls were employed for dyestuff. Many specimens found generally.

Hicoria pecan (Marsh) Britton. Pecan.
Hicoria cordiformis (Wang.) Britton.
Hicoria laciniosa (Michx. f.) Sarg. King nut. Big shagbark.

Many specimens of this species were found.

Hicoria alba (L.) Britton. Mocker nut.

BETULACEAE

Corylus americana Walt. Hazelnut.

The nuts were used for food, and the wood was employed for making foreshafts for darts, and for other such purposes. Very many specimens were found of both nuts and wood.

FAGACEAE

Castanea pumila (L.) Mill. Chinquapin.

Nuts were used for food.

Quercus borealis maxima (Marshall) Ashe. Red oak.
Quercus palustris Du Roi. Pin oak.
Quercus coccinea Wang. Scarlet oak.
Quercus marilandica Moench. Black-jack oak.
Quercus imbricaria Michx. Shingle oak.
Quercus macrocarpa Michx. Bur oak.

Very many acorns of all these species were found stored away in woven bags, apparently being an important item in the Bluff-Dwellers' food-supply.

ULMACEAE

Ulmus fulva Michx. Slippery elm.

MORACEAE

Morus rubra L. Red mulberry
Toxylon pomiferum Raf.

AMARANTHACEAE

Amaranthus sp. Amaranth. Pigweed.

Sheaves of the seed heads of a species of Amaranth which appeared to have been put away for seed indicate that this plant was cultivated to some extent at least. In Mexico, Central America and South America closely related species of Amaranthus are now cultivated as a grain food and have been since prehistoric times. Whether the plant was cultivated by the Bluff-Dwellers or not, it is evident that they used its seeds for food. Probably they also used the tender stems and leaves as greens.

CHENOPODIACEAE

Chenopodium sp. Goosefoot. Lamb's-quarters.

Sheaves of seed heads of a species of Chenopodium were found put away with other stored seeds, probably indicating the cultivation of this plant. Species of Chenopodium were cultivated for food in South America, Central America and Mexico in pre-Columbian times, and still are at the present time. The specimens found in Bluff-Dweller remains appeared to be *Chenopodium nuttalliae* Safford (or a species related most closely to it) and this is a species still cultivated in Mexico.

Du Pratz, in his *Histoire de la Louisiana*, 1 : 316–317, mentions the use and partial cultivation by the Natchez of a plant which he called "belle-dame-sauvage," "wild belle-dame." Now "belle-dame" is the French name of Chenopodium which grows in Europe, and so when he saw in America a species of the plant which

he knew at home as "belle-dame," he called it "wild belle-dame." Du Pratz says: "After this sowing and this kind of cultivation they wait until autumn, and then gather a great quantity of this grain. They prepare it like millet, and it is very good eating." It appears, therefore, that this species of Chenopodium which the Ozark Bluff-Dwellers used, and probably cultivated, was still in use and cultivation by some of the southern tribes at the time the French came.

ANONACEAE

Asimina tribolata (L.) Dunal. Papaw.

One papaw seed was found. $\frac{1}{6}\frac{1}{5}\frac{1}{0}\frac{1}{8}$. Most probably this fruit, in season, was an occasional food of the Bluff-Dwellers, as it has been with the Indians of historic times.

PLATANACEAE

Platanus occidentalis L. Sycamore.

One specimen was found. $\frac{1}{7}\frac{1}{3}\frac{1}{9}\frac{1}{5}$.

ROSACEAE

Prunus chicaca Mich. Chickasaw plum.

It is rather curious that this was the only representative of the Rose family which was found, and that there was only one specimen of it. $\frac{1}{9}\frac{1}{1}\frac{1}{7}\frac{1}{4}$. This was a plum pit perforated to make a bead. It is very probable that numbers of other species of several genera in this large and useful family were utilized, especially drupaceons and berry fruits.

CESALPINACEAE

Gleditsia triacanthos L. Honey locust.

This tree was represented in the finds by one specimen. $\frac{1}{8}\frac{1}{8}\frac{1}{0}\frac{1}{6}$.

FABACEAE

Lespedeza capitata Michx. Rabbitfoot clover.
Phaseolus vulgaris L. Garden bean.

Stores of garden beans of several varieties were found at all the sites.

ANACARDIACEAE

Rhus glaba L. Smooth sumac.

Many empty panicles were found, but no fruits. Probably the fruits had been removed from the panicles. They probably were used, as they were by Indians of historic times, in dyeing processes, or medicinally.

SAPINDACEAE

Sapindus drummondii H. & A. Soapberry.

One specimen was found. $\frac{1}{6}\frac{1}{2}\frac{1}{7}\frac{1}{5}$. Its use, if it had any, we do not know. Its berry may have been used as soap is used in washing.

VITACEAE

Vitis spp. Wild grapes.

Abundant remains of all the species native to the region were found at all the sites. They were evidently very much in use for food, and probably for dyeing also, as among Indians of historic times.

TILIACEAE

Tilia americana L. Linden. Basswood.

Bast fibers of this tree were much used for making twine and cordage.

THYMELACEAE

Dirca palustris L. Leatherwood.

The bark was used in strips for tying and binding, as leather thongs were used.

CORNACEAE

Cornus amomum Mill. Kinnikinnik
Cornus asperifolia Michx. Rough dogwood.

The straight young shoots of both these species were probably used for making foreshafts for darts.

SAPOTACEAE

Diospyros virginiana L. Persimmon.

This fruit was evidently an item of food of the Bluff-Dwellers. It had great importance among southern tribes in historic times.

OLEACEAE

Fraxinus sp. Ash.

The wood of this tree was used for various purposes.

APOCYNACEAE

Apocynum cannabinum L. Indian hemp.

Many specimens were found of the fibers of this plant, and of thread, twine and cordage made from the fiber.

BORAGINACEAE

Onosmodium subsetosum Mack. & Bush. Ozark false gromwell.

Seeds of this plant were used to make beautiful, pearly white small beads.

SCROPHULARIACEAE

Dasystoma sp. False foxglove.

A ripe stalk of the seed vessels of this plant was found, but it is not known whether it had any use. $\frac{1}{6}\frac{1}{5}\frac{1}{7}\frac{1}{0}$.

BIGNONIACEAE

Catalpa speciosa Warder. Catalpa.

Specimens of the seed vessels of this tree were found, but no use of them is known.

CAPRIFOLIACEAE

Viburnum sp. Viburnum.

A single seed was found of a species of Viburnum. $\frac{1}{5}\frac{1}{6}\frac{1}{9}\frac{1}{6}$.

CUCURBITACEAE

Cucurbita maxima. Winter squash.

A part of a shell and the peduncle of a squash of this species were found, and in several situations seeds were preserved.

Cucurbita ovifera. Egg gourd.

A complete shell of this species was found. $\frac{11}{6575}$.

Cucurbita pepo. Pumpkin and summer squash.

A complete shell of a round flat summer squash was found. $\frac{11}{7360}$.

AMBROSIACEAE

Iva xanthifolia (Fresen.) Nutt. Marsh-elder. Half-breed weed.

Quantities of seeds of Iva were found. A very interesting and curious fact is that the seeds in the stores were of a size much larger than any now growing as weeds. This suggests that all these larger seeds in the stores of the Bluff-Dwellers may have been the product of cultivation. The purpose for which they were used is problematic.

Ambrosia trifida L. Giant ragweed.

Considerable quantities of seeds were found apparently of this species, but much larger and of uniform light color, suggesting cultivation and selective breeding. In studying the possible and probable uses of this plant by the Bluff-Dwellers I considered the eagerness with which the seeds of it are sought by birds. I gathered a quantity of newly ripened seeds to try their suitability for human food. I found them palatable and rich in food values. From this quality and from the select appearance of the specimens discovered in the stores laid up by the Bluff-Dwellers I concluded that the plant was cultivated by them as a grain crop for food.

COMPOSITAE

Liatris squarrosa (L.) Hill. Blazing star.

This was probably used medicinally, as it is still employed by Indians.

Liatris pycnostachya (Michx.) Kuntze. Kansas gayfeather.
Helianthus annuus L. Sunflower.

Quantities of seeds of at least two cultivated varieties of this species were found, commonly in connection with the food stores and selected seed supplies in many sites. Parts of sunflower heads also were found, and both these and the shelled seeds indicated that the sunflowers cultivated by the Bluff-Dwellers were in no way inferior to the cultivated ones with which we are acquainted at the present time.

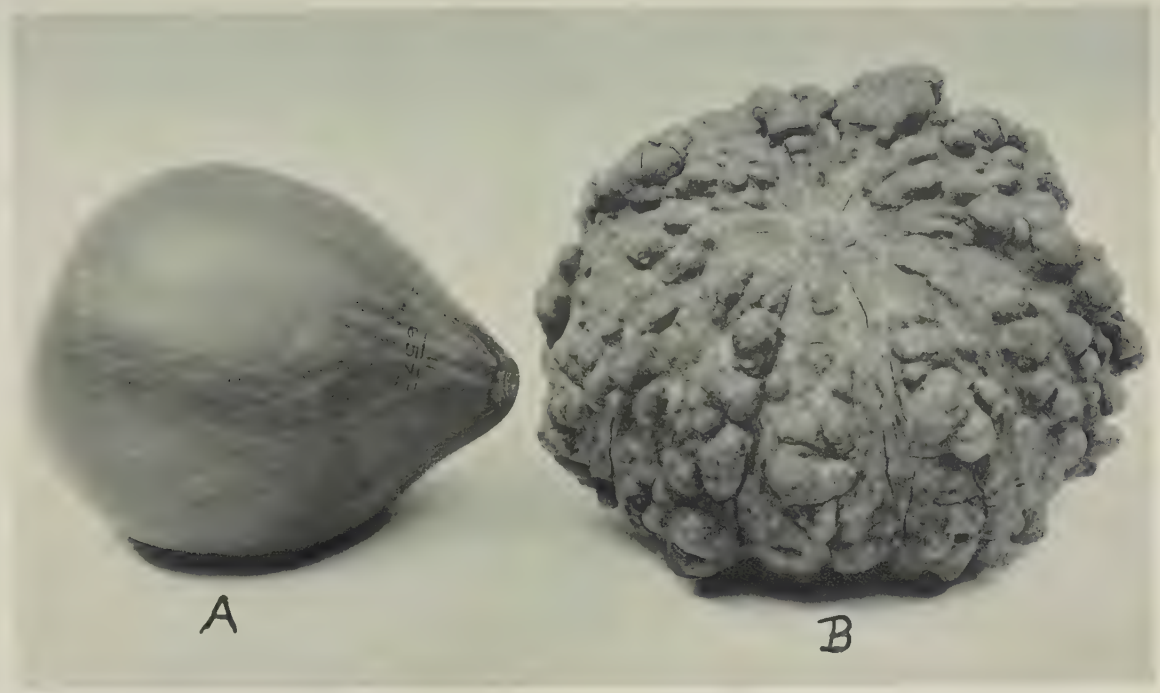
Cirsium altissimum. Thistle.

A leaf of this species of thistle was found.

Rudbeckia sp. Cone Flower.

A disk of a species of Rudbeckia was found. No suggestion can be offered as to its use, if it had any.

University of Michigan



A. Egg gourd

B. Summer squash

FIG. 1. Bundle of grass heads
(*Phalaris caroliniana*)

FIG. 2. Dent corn

SPIRIT STONES

WILBERT B. HINSDALE

NO WRITER has better described the mysticism of the Indian and his simple philosophy than Addison in the *Spectator* two hundred and twenty years ago. He says: "The Americans believe that all creatures have souls, not only men and women, but brutes, vegetables, nay, even the most inanimate things, as stocks and stones. They believe the same of all works of art, as knives, boats, looking-glasses; and that as many of these things perish, their souls go into another world, which is inhabited by the ghosts of men and women. For this reason they also place by the corpse of their dead, food, a bow and arrows, that he may make use of the souls of them in the other world, as he did of their wooden bodies in this. How absurd soever such an opinion may appear, our European philosophers have maintained several notions altogether as improbable." [1]

Although the Indian's religion did not have a personal god, or a pantheon of divinities, he recognized what has been variously described as "the supernatural," "a mystic potency," "the more than human," "cosmic reality," "determiner of destiny," "a mystery of purpose," or an "X" which possesses some "transcendent power concretely divine."

Nowhere in the world did men reverence "stocks and stones" as such. Everything in nature possessed a "power" and it was the power, usually referred to as spirit, that evoked awe and occasionally ceremony.[2] Whatever was unusual in shape, color, movement or situation caused the Indian, as he passed by, to hesitate and perform acts that may not have been worshipful, but they were reverentially respectful, and his ceremonies, upon such occasions, may well be described as religious.

[1] *The Spectator in Miniature*, from the second London edition (A. Sherman, Phila., 1826), 1 : 65.

[2] Brinton, Daniel G., *Religions of Primitive Peoples*, p. 131.

With this introduction, I will proceed to locate and describe briefly numerous natural stone or mineral objects in Michigan that, for want of a better term, may well be characterized as spirit stones. Perhaps the better way will be to observe some order of geographical situation. We shall follow around the lake shore, beginning at Detroit, and then note some inland objects.

In 1669 the Sulpitian priests, Galinée and Dollier, passed through the Detroit River and Lake St. Clair. They arrived at Detroit in the spring of 1670. In his journal Galinée says that six leagues from Lake Erie he found a "stone idol" which the Indians regarded as influencing navigation of Lake Erie, and to which they made sacrifices of skins and food whenever they were about to embark upon the lake. "They broke one of their hatchets, in breaking the idol to pieces, and then threw it into the river, adding 'God rewarded us for the pious deed, for we killed during the same day a deer and a bear.'"

In referring to this incident, Mr. Bela Hubbard remarks: "Sacred stones were not uncommon in these parts. I have seen several such altars, sometimes in the most wild and lonely situations, invariably covered with bits of tobacco and other petty gifts." [3]

Mr. Hubbard gives the following description of a situation he visited at the mouth of the Kawkawlin River, Saginaw Bay, in 1837: "Upon a swelling knoll, overlooking the bay, in the midst of a tract of country from which all timber had been burned, was a spot which seemed to have been dedicated to the evil Manitou. Here an altar was erected, composed of two large stones, several feet in height, with a flat top and broad base. About were several small stones which were covered with propitiatory offerings, — bits of tobacco, pieces of tin, flints, and such articles, of little value to the Indians, as, with religious philosophy, he dedicates to his Manitou." [4]

Mystery stones were common along the Lake Huron shore. Through the southern part of Alpena County flows Devil River,

[3] *Michigan Pioneer Collections*, 3: 649.

[4] Hubbard, B., *Memorials of a Half-Century* (G. P. Putnam's Sons, New York, 1887), pp. 85–86.

originally called Rivière Au Diable by those who spoke the French language, a name significant either of swampy lands in the vicinity, or of the peculiar behavior supposed to reside in the stones to be described. The account is taken mostly from the *Centennial History of Alpena County, Michigan*, by Mr. David D. Oliver.[5]

When Mr. Oliver, a surveyor, first visited Devil River in 1839, he saw near its mouth two large stones standing together. One was a gneiss rock with bands of quartz, which had been much worn by wind and water and weighed about three hundred pounds. The other stone was in the shape of the human body, but without head, arms or legs. Near and around the stones were large numbers of pipes, tobacco, beads, ear jewels, silver brooches, buttons and various kinds of trinkets.

There was a story that Shin-gaw-ba, a divine chief, lived there a long time ago. He told his people he would come back to the stones for the presents that they might leave for him. The Indians called the place Shin-gaw-ba-waw-sin-eke-go-ba-wat-waw-sin-eke, signifying "image stones." Out of the long Indian phrase Mr. Oliver made the name Waw-sin-eke for the township, the whole Indian name being too long to retain. It was misspelled and Ossineke, the name of a small hamlet that stands there now, is the outcome of it.

There is an interesting legend about the two stones, which is as follows: Some Iroquois captured two Chippewa near the river and put them and their images into a canoe and started across Thunder Bay with them. When they were in the middle of the bay, the stones were thrown into the water. Suddenly the water boiled and spouted up; the canoe capsized and the Iroquois drowned, but the Chippewa escaped and rescued the canoe. When they returned to the place whence they started, they found the stones had preceded them and were standing in their places as they had done before being removed. These valuable relics were finally broken up by fishermen and used for net anchors. Mr. Oliver states that "These stones are found throughout the country of the Chippewa."

[5] Oliver, D. D., *Centennial History of Alpena County, Michigan* (Argus Printing House, Alpena, Michigan, 1913), p. 25.

The Lake Huron shore, Presque Isle County, from the Waw-waugh-waugh-gue-oc River, which is now called Ocqueoc, to the Swan River, a distance of twenty miles, seems to have been held by the Indians of long ago as "sacred ground." There is an interesting legend connected with the Sacred Rock, situated six miles up the shore from Rogers City. The rock is a huge, conglomerate boulder, 20 feet long, 6 feet high and 8 feet in transverse dimension. It was quite regularly rectangular, but its angles have been rounded by wave and weather action. It stands at the edge of the water when the lake is low, but at high level of the lake it is a hundred or more yards from the beach. The Indians coming down the shore offered sacrifices of dogs and left other offerings upon the rock. In August, 1926, when it was visited by a member of the University of Michigan Museum staff, two or three small piles of tobacco were observed, indicating that the Indians living in the locality still observe some of the sacred rites.

The late Frederick Denny Larke wrote, in 1909, the following: "The history of the Sacred Rock is this: Ages ago, where the rock now stands, was the boundary line between the hunting grounds of two Indian tribes; the chief of the one was exceedingly aggressive and frequently trespassed upon the preserves of the neighboring tribe, and, in so doing, had caused much trouble and bloodshed to follow these excursions. At last the chiefs of the two tribes met, when the one as usual was trespassing over the border, and an altercation ensued which would probably have again resulted in a bloody war between the conflicting tribes, but Kitchie Manitou, the Great Spirit, who was up Lake Superior at the time, became disgusted with both of them, seized hold of the Sacred Rock and hurled it down, crushing both the chiefs beneath its immense weight, which was so great, that the banks above the beach have been sliding and trembling ever since. Hence the Rock became an object of worship to the Indian races."[6]

Mr. Larke also relates the following story: "The mouth of Swan River, southeast of Rogers City, was also considered a sacred spot, probably because a tide sets in at intervals every day, and logs or boats launched upon or thrown into the stream will float against

[6] Unpublished manuscript.

the current of the river. In the writer's time, Indians brought down an old squaw who was aged and crippled, and drowned her in the mouth of Swan River. She appeared to be perfectly contented to be immolated in this manner, it being, as the writer was led to understand, the usual custom in such cases."

There was found, in 1820, on Thunder Bay Island, toward which point, according to the story by Oliver, the Iroquois had started with the Ossineke stones, a stone with a circular flat base and a long slender arm, which had been set up under a tree and "in its solitary, desolate aspect furnished a place eminently appropriate, according to the Indian's superstition, for the residence of a Manitou or spirit." [7]

Four miles north of St. Ignace is Rabbit's Rock. From a distance it has the outline of a sitting rabbit and is a legendary spot. It is an immense, high rock, and on account of its shape was supposed by the Indians to be inhabited by a manitou. When they paddled by, they would stop and make offerings of tobacco, supposing it to be a great spirit that once presided over their ancestors, and they always treated it with reverential respect.[8]

Father Gagnieur states that the Pictured Rocks off the shore of Alger County were famous in Indian legend. In one of the coves was an "altar" which the Indians used for ceremonial purposes.

No doubt Mackinaw Island, which is almost entirely of rock, was regarded as a prodigious and powerful manitou. Manitou Islands, in Lake Michigan, belonging to Leelanau County, have thrilling legends connected with them. On account of the belief that they were the abodes of spirits that would work evil, they were usually avoided by Indian canoemen or approached with the greatest circumspection and propitiatory offerings.[9]

Of Hubbard Lake, the largest lake in Alcona County, much has come down in legend about its sacredness to Indian tribes who fre-

[7] Squier, E. G., *Antiquities of the State of New York* (Geo. H. Derby & Co., 1851), p. 171.

[8] Gagnieur, Rev. Wm. F., S. J., "Indian Place Names in the Upper Peninsula, and Their Interpretation," *Michigan History Magazine*, 2 (1918): 532.

[9] Blois, John T., *Gazetteer of the State of Michigan* (Sydney L. Rood & Co., Detroit, 1838), pp. 317–318.

quented its shores. Even in more recent times there remained on the southern end of the lake, on an elevation commanding a bird's-eye view of the great stretch of water, a weird monument of stone called "Indian Worship," a sacred relic of early aboriginal days. The story is that this stone was erected to mark the burial-place of Se-don-i-ka-to, a great Chippewa chief, and that Indian hunters and trappers, and even some white men of earlier days often brought offerings of beads and tobacco and left them at the monument as an act of worship. "Old-timers" remember this stone image as having a hollow head, or an opening in the natural stone formation of the head, and recall that the votive offerings were placed in this cavity. Some Alcona County residents of today tell of having seen, in their younger days, some of these votive offerings at the "Indian Worship" stone. This historical spot has been desecrated, the grave dug up, and report has it that the stone was taken away by some Pittsburg people in 1880.[10]

"Between Grand Blanc and Flint the Indian trail passed over a beautiful rise of ground, which the Indians had cleared and surrounded with plum trees, which bore a large amount of wild plums, red and yellow, the finest I ever saw. This spot was, perhaps, forty or fifty feet in diameter, the trail passing through nearly in the center of this beautiful, green grass spot, where all travelers, both white and Indian, stopped. The Indians always stopped, as it was a place of Indian worship. Beside the trail, nearly in the center of this spot, stood a very peculiarly shaped stone, perhaps four feet high, erected by the Indians as one of their idols or gods. They called it Bab-o-quah." This manitou was taken away by Captain Jacob Stevens, in 1823–24, but the Indians forced him to return it.[11]

Mr. Williams, at an early date, visited a sacred rock on the Pine River "not far above the present St. Louis, in Gratiot County. We examined the boulder and found it was worn quite smooth by the Indians. It was a sacred Indian god which they all stopped

[10] Stannard, Mae E., and Hunzicker, Beatrice Plum, "Glimpses of Huron Shore in Early Days and the Story of Harrisville," *Alcona County Review*, 1926, p. 4.

[11] Williams, Ephraim S., *Michigan Pioneer and Historical Collections*, 10: 139–140.

and worshiped by a speech or a smoke. They also left other articles in addition to pieces of tobacco, and among them were pieces of copper which we afterward learned were cut from the copper boulder on the Ontonagon River, Lake Superior. . . ."

"Nearly every Indian has discovered such an object in which he places special confidence, of which he most frequently thinks, and to which he sacrifices more zealously than to the Great Spirit. They call these things their 'Manitou personnel' but the proper Ojibbeway word is said to be 'Nigouimes,' which means 'my hope.' One calls a tree, another a stone or block, 'his hope.' Thus, for instance, on the mainland, opposite La Pointe, there is an isolated boulder and huge erratic block, which the Voyageurs call 'le rocher' or 'la pose de Otamigan.' . . . This rocher de Otamigan is in a swamp close to one of these *poses* [resting places]." There is also quoted here the legend of Otamigan, and how he selected this rock for his manitou: ". . . he (the Indian) never goes past it without laying some tobacco on the rock as a sacrifice, and often goes expressly to pay worship to it." [12]

There was quite an eminence back of the cantonment at the Sault Ste. Marie, called by the French La Butte de Terre, and Wudjuwong ("Place of the Mountain") by the Indians. Not far from this eminence stood a hollow mountain ash of unusual size. Tradition says a drumlike sound, upon pleasant days, was emitted from the tree. From year to year the offerings of the Chippewa had accumulated in large quantity at this place. The vicinity had been considered the haunt of a spirit. Hence the propitiatory offerings.[13]

An image of black bronze is described in the *Journal of Father Claude Allouez's Voyage into the Outaouac Country, 1666–67.* "There is observed in those regions (of the Ottawas) a kind of idolatry which is rather unusual. They have a grotesque image of black bronze, one foot in height, which was found in the country, and to which they give a beard like a European's, although the

[12] Kohl, J. G., *Kitchi-Gami* (London, 1860), p. 58.

[13] Schoolcraft, H. R., *Personal Memoirs of a Residence of Thirty Years with the Indian Tribes on the American Frontiers,* A.D. *1812 to* A.D. *1842* (Lippincott, Grambo & Co., Phila., 1851), p. 99.

savages themselves are beardless. There are certain fixed days for honoring this statue with feasts, games, dances and even with prayers, which are addressed to it with divers ceremonies. Among them is one which, although ridiculous in itself, is yet remarkable in that it embraces a kind of sacrifice. All the men, one after another, approach the statue and, in order to pay it homage with tobacco, offer it their pipes, that it may smoke; but, as the idol cannot avail itself of the offer, they smoke in its stead, blowing into its face the tobacco-smoke, which they have in their mouths,—which may be regarded as a mode of offering incense, and performing sacrifice." By "black bronze" the father means of course copper.[14]

A farmer living in Houghton County unearthed a piece of float copper which presents a striking resemblance to a human profile. It was an accidental find. There is no positive evidence for thinking so, but it had probably been an object of veneration. The greatest diameter of the specimen is forty inches, the weight four hundred and eighty-four pounds. There is no legend connected with it, and the reason for calling it a "spirit" object is conjectural. Its story is short. It is now placed in the Museum of Mineralogy of the University of Michigan.

Kohl says in *Kitchi-Gami*, pp. 60–61: "Among the dead stuffs in nature, the dwellers on Lake Superior seem to feel the most superstitious reverence for copper, which is so often found on the surface soil in a remarkable state of purity. . . . Large masses of metallic copper are found at times in their forests. . . . Admiration leads the savage to adoration, and thus these masses of copper began to be regarded by nearly all the Ojibbeways as something highly mysterious, and were raised to the dignity of idols." An Indian friend whom Kohl asked for a certain lump of copper which was in the forest replied: ". . . it is a great treasure to me. It was so to my father and grandfather. It is our hope and our protection. Through it I have caught many beavers, killed many bears. Through its magic assistance, I have been victorious in all my battles, and with it I have killed our foes. Through it, too, I have

[14] Kenton, Edna, *The Indians of North America*, 2: 164, quoting Le Mercier's *Relation, 1664–65*, xlix, Doc. CXVII, pp. 241, 243.

always remained healthy, and reached that great age in which thou now findest me." After Kohl had secured the piece of copper, the Indian placed a quantity of tobacco in the hole in the ground from whence it had been lifted.

The Ontonagon copper boulder, weighing three tons, which finally found a resting place in the National Museum after many vicissitudes in transit, is declared to have been "worshiped as a manitou by superstitious Indians during uncounted years." [15]

The descriptions that have been given are confined to natural objects that evoked the suspicion and veneration of the Indians as they found them in place. It is said that occasionally the objects had been bedaubed with paint, probably to "bring out the features" more distinctly. Some of them have been referred to as "idols," but idols are usually man-made effigies to represent deities and belong to a different, if not a higher, grade of worship than the mere abiding place of *orenda* or *mana* in a natural object.

At certain places the Indians had made stone piles, built up one stone at a time by passers-by. These heaps, no doubt, were located at certain spots where some event had occurred, or where previously a "spirit tree" had stood. There are not many records of Indian stone piles in Michigan. Some very symmetrical stone mounds stood in Macomb County, but they had been built up with care and contained human skeletons.

Both isolated stones of veneration and the heaps had a very wide distribution, and were not distinctive of Indian culture. Tobacco pipes, especially those of peculiar material like catlinite, were nothing more or less than transportable spirit stones or diminutive altars. Catlinite was considered sacred, and before breaking off pieces for pipes, one asked permission from the presiding spirit. Although it is going far afield for an illustration, Lot's wife cannot be better described than by calling her, after she became a "pillar of salt," a spirit stone. If there was a "pillar of salt" at all by the Dead Sea, it stood there ages before the legend of "looking back" was associated with it.

[15] Moore, Charles, *Report of U. S. National Museum, Washington* (Government Printing Office, Washington, 1897), p. 1023.

No mention can be made of lakes, springs, streams, waterfalls, caves, hills, mountains or trees that were the depository of votive offerings, although they would classify under the general term "spirit objects."

University of Michigan

INDIAN OCCUPATION AND USE OF THE CHAMPLAIN LOWLAND

ERIC P. JACKSON +

OUTLINE

Introduction
A. General character of occupation
  Comparison with Onondaga County, New York
  Successive occupation by different groups (evidence from archaeology, history, place-names, legends)
  General density of distribution of sites
B. Occupation along the lake shore
  Northeastern district
    Missisquoi section
    Sheltered bays (type, Malletts Bay), islands, other sites
  Northwestern district
    Isle la Motte
    Plattsburg section
    Other sites
  Middle district
    New York shore
    Vermont side of lake
  Southern district
    Upper stretch of Lake Champlain; Lake George.
  Importance of focal points
    Colchester Point and the lower valley of Winooski River
    Ticonderoga section
C. Penetration inland
  Importance of hydrographic focal areas
  Significance of inland swamps
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E. Indian habitations
  The family wigwam; supplementary use of earth
  Rock shelters and caves
  Lack of large Indian towns
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+ Editors' Note — The writer of this paper, Dr. Eric P. Jackson, met death by motor accident on June 11, 1930, near Grenoble, France. His

Introduction *

A LONG narrow waterway, Lake Champlain, stretched north and south amidst the great wilderness that originally covered New York and New England. This lake and its valley formed an all-important thoroughfare for the Indians, as it did later for the whites. This valley, then, was an important highway for various Indian tribes that traversed the wilderness in the course of their seasonal nomadism or of their wartime movements.

During the winter months, of course, the Indian was forced

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untimely fate removes from the membership of the Michigan Academy one of its most promising younger members.

Dr. Jackson was born on February 7, 1899, at Fall River, Massachusetts. As professor of geography, he was a member of the faculties of Middlebury College, Vermont, 1924–25, and Hillsdale College, Michigan, since 1926. He was awarded an American Field Service Fellowship for French Universities in 1929. At the time of his death he was on a year's leave of absence, during which he was engaged in research work in the French Alpes. He was particularly interested in mountain geography, a field in which he had done a great deal of work.

Dr. Jackson had no opportunity to see this paper in print. To his wife, Mrs. Hilda S. Jackson, the editors are indebted for careful handling of the manuscript and proof.

* This paper is essentially Chapter II of a complete study made by the author of the early Indian geography of the Lake Champlain region, in preparation for the Ph.D. degree in geography at the University of Chicago (see Bibliography, page 158, for complete citation of the dissertation). This chapter as presented here lacks thirty-four photographs and three large-scale sectional maps included in the original. A summary was read before the Geography Section of the Michigan Academy of Science, Arts and Letters at the 1929 meeting.

In addition to this chapter, the complete study includes (1) the reconstruction and detailed consideration of the aboriginal highways (both water routes and land trails) within the region and its tributary border lands (Chapter I), and (2) an analysis of the various activities carried on by the Indians as related to the natural environmental complex and to the regional relations of the lowland (Chapter III). The entire investigation necessitated reconnaissance field work, critical examination of relevant literature and materials (geographical, historical, archaeological and geological) in libraries, museums and elsewhere, and two and one-half months of intensive field work (1926). The problem was begun in 1924–25, when the author was instructor in geography and geology at Middlebury College, Middlebury, Vermont.

A 2,900-word abstract of the entire study, giving a summary and listing the chief conclusions reached, is to be found in the annual volume of these abstracts, science series, published by the University of Chicago Press.

to do all of his traveling on foot. Furthermore, his activities were such that a great deal of his journeying had to be done at that time. The red man chose his trails well, for in many places those made later by the white man — bridle paths, roads, canals, railroads — have used the same lines that he followed.

A. General Character of Occupation

The Champlain Lowland (Vermont–New York) was occupied irregularly by the Indians, and was relatively free from what may be termed permanent settlement. It was a great natural highway connecting other important regions (i.e. the St. Lawrence Lowland to the north and the Hudson Valley to the south), and this highway was often a warpath for hostile groups, thus explaining the important reasons for the nature of its occupation. Coupled with these circumstances is the fact that this region furnished admirable hunting and fishing grounds. There are sections of the area that were well suited for permanent occupation, but their value was considerably lessened by the presence of the lake, a north-south doorway open to all enemies. In times of peace, tribes from surrounding regions came into this wilderness to exploit it for things they desired. A study of the character and distribution of such of their occupied "sites" as are known [1] brings out the ways in which, and the extent to which, they utilized the lake and its shores, as well as the inland forests and waters to which they penetrated.

As might be expected, Indian sites are less closely grouped in this region than in the regions to the north and south where the Algonkians and the Iroquois had their chief settlements. A comparison between the Champlain Lowland and the Onondaga County, New York,[2] is significant (see Map 1):

[1] These sites are the best available index that we have of the density of the Indian population and the uses to which they put the area. The evidence is very incomplete because usually the only sites that have come to our notice are the ones that were occupied several times or continuously for some time. Furthermore, much of this evidence has been obliterated or has not been reported by later inhabitants.

[2] Onondaga County, which is in what was the heart of the Iroquois country, was for centuries the stronghold of the tribe of that name, perhaps the strongest of the so-called Six Nations. It comprises the country south and west of the present city of Syracuse, New York.

Item	Champlain Lowland [3]	Onondaga County [4]
Village sites	57	16
Camp sites	50	27
Traces of occupation	24	—
Hamlets and lodges	—	40
Stockades, earthworks, etc.	—	22
Cemeteries	6	24
	137	129

COMPARISON WITH ONONDAGA COUNTY, NEW YORK

Considering the fact that the Champlain Lowland is more than three times the size of Onondaga County,[5] it is evident that, although there are a few more sites in the former, the density of Indian settlement in the latter was considerably greater. The larger number of camp sites in the Champlain region is striking evidence of the temporary nature of the occupancy, due in part to the highway character of the region. The more numerous occurrence of village sites might at first seem to indicate permanent settlement, but most of these were villages set up near hunting and fishing grounds, and probably they were occupied for only a few months of the year. For the most part, the hamlets and lodges in Onondaga County were the relatively permanent home sites of

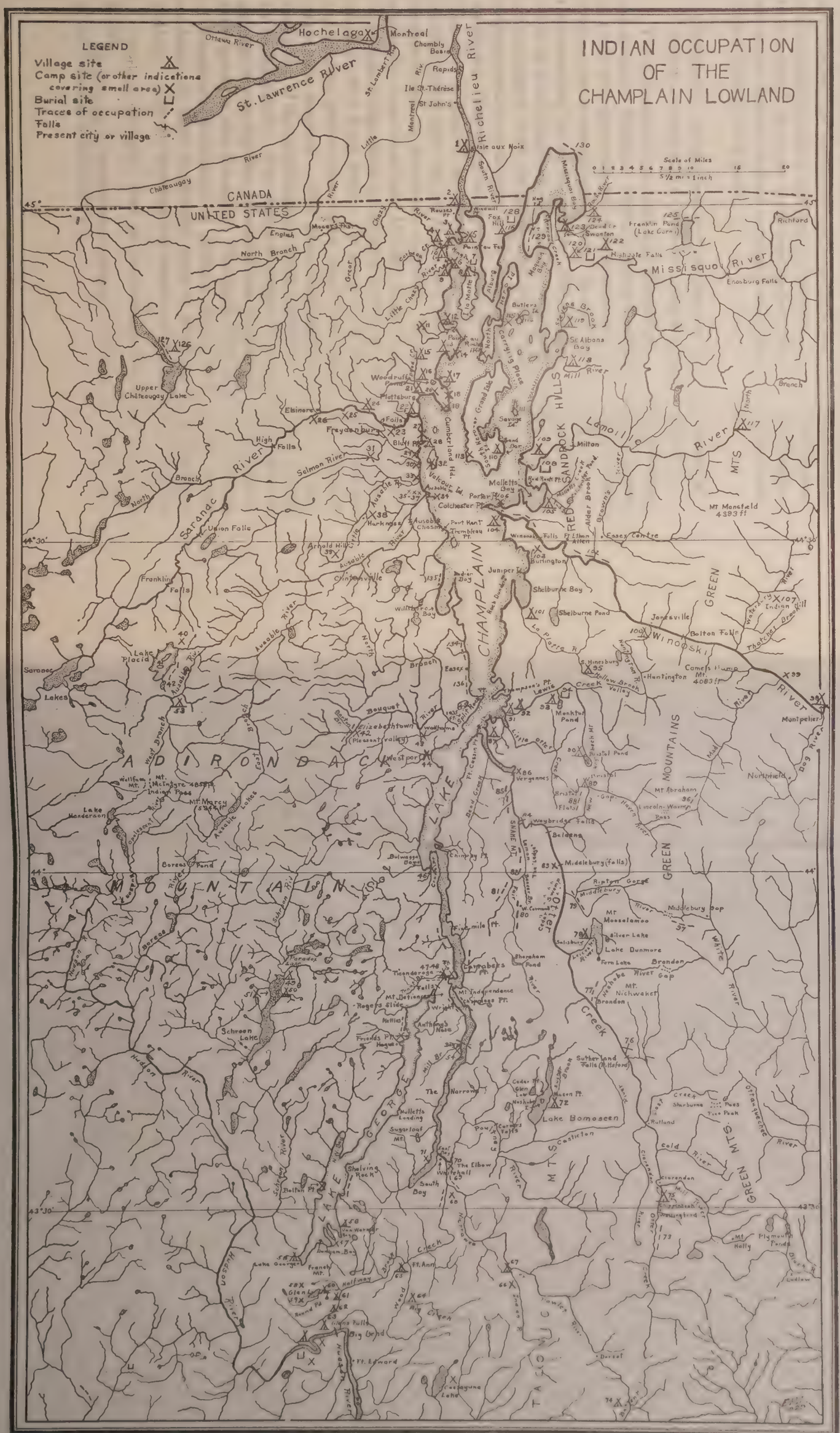
[3] These are the numbered sites on the accompanying map of the Indian Occupation of the Champlain Lowland (after p. 116). Some thirty or forty sites are outside the lowland proper, although they are, for the most part, within the Champlain drainage basin. They include the sites along the tributary trails and are all associated to a greater or lesser degree with the Indian geography of the lake and its shores.

In general, the archaeological evidence from the Champlain Lowland is less well standardized and less complete than that from Onondaga County. In the former, the work has been done at different times by different men; there has not been complete correlation (e.g. by a state archaeologist); and many sites are merely chance reports of untrained observers and writers. If evidence were more extended, the numerous "traces of occupations" here listed could be classified otherwise; the number of cemeteries, or at least burial sites, might be greater; and there would be some "hamlets" and "earthworks."

[4] Data summarized from Parker, A. C., *The Archaeological History of New York*, Part II, section on Onondaga County.

[5] This county is not over 35 miles from north to south at its greatest extent.

The Champlain Lowland lies largely on the eastern or Vermont side of the lake and nowhere appears to exceed 25 miles in width. Lake Champlain itself is 126 miles in length from South Bay to the head of Missisquoi Bay.


INDIAN OCCUPATION OF THE CHAMPLAIN LOWLAND
LEGEND
Village site
Camp site (or other indications covering small area)
Burial site
Traces of occupation
Falls
Present city or village
Scale of Miles
5 1/2 miles 1 inch
CANADA
UNITED STATES
St. Lawrence River
Ottawa River
Hochelaga
Montreal
Chambly Basin
Rapids
Ile St-Thérèse
St John's
Richelieu River
Little Chateaugay River
Chateaugay River
English River
North Branch
Great Chazy River
Little Chazy River
Saranac River
Upper Chateaugay Lake
High Falls
Salmon River
Union Falls
Ausable River
Franklin Falls
Lake Placid
Saranac Lakes
Bouquet River
Boquet River
Westport
Elizabethtown
Wadhams
Willsboro Bay
Willsboro Point
Essex
Split Rock
Port Kent
Trembleau Pt.
Ausable Chasm
Arnold Hills
Clintonville
Plattsburgh
Cumberland Hd.
Valcour Is.
Colchester Pt.
Porter Pt.
Malletts Bay
Burlington
Juniper I.
Shelburne Bay
Shelburne Pond
Winooski Falls
Ft. Ethan Allen
Essex Centre
Jonesville
Winooski River
Huntington
Camels Hump Mt. 4083 ft
Hinesburg
Mt. Mansfield 4393 ft
Richford
Franklin Pond (Lake Carmi)
Swanton
Missisquoi River
Enosburg Falls
Milton
Lamoille River
Mill River
St Albans Bay
Butlers Pt.
Grand Isle
Isle La Motte
Alburg
Rouses Pt.
Fox Hill
Point au Fer
Missisquoi Bay
Lake Champlain
Champlain Valley
Red Rock Pt.
Alder Brook
Brown's River
Green Mts
Adirondack Mountains
Lake George
Lake Bomoseen
Lake Dunmore
Mt. Moosalamoo
Mt. Abraham 3611
Lincoln-Warren Pass
Mt. Nichwaket
Brandon
Middlebury
Middlebury Gap
Weybridge Falls
Belden
Bristol
Bristol Pond
Monkton Pond
Hinesburg
Huntington
Camels Hump
Montpelier
Northfield
Barre
Plymouth Ponds
Mt. Holly
Rutland
Castleton
Poultney
Whitehall
Ticonderoga
Crown Point
Mt. Defiance
Mt. Independence
Rogers Slide
Anthony's Nose
Friends Pt.
Hague
Schroon Lake
Hudson River
Glens Falls
Lake George
Fort Edward
Fort Ann
Whitehall
Shelving Rock
South Bay
Sugarloaf Mt.
The Narrows
The Elbow
Cedar Pt.
Glen Lawn
Nasons Pt.
Sutherland Falls (N. Hsford)
Sharon Springs
Orwell
Otter Creek
Lemon Fair River
Cold River
Mt. Independence
Lake Champlain
Lake Memphremagog
Derby
Newport
Barton
Orleans
Lyndonville
Ludlow
Dorset
Manchester
Bennington
Hoosick River
Walloomsac River
Battenkill River
Mettawee River
Poultney River
Otter Creek
Lemon Fair River
Cold River
Mill Brook
Indian Brook
Hubbardton River
Castleton River
Hudson River
Lake George
Schroon River
Boquet River
Ausable River
Saranac River
Chateaugay River
Little Chazy River
Great Chazy River
Salmon River
Lamoille River
Winooski River
White River
Mad River
Dog River
Green River
Missisquoi River
Trout River
Black Creek
Otter Creek
Lemon Fair River
Cold River
Mill Brook
Indian Brook
Hubbardton River
Castleton River
Hudson River
Lake George
Schroon River
Boquet River
Ausable River
Saranac River
Chateaugay River
Little Chazy River
Great Chazy River
Salmon River
Lamoille River
Winooski River
White River
Mad River
Dog River
Green River
Missisquoi River
Trout River

Map 1

INDI
DE
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families and groups of families. One of the most convincing proofs of the scarcity of permanent settlements in the Champlain country is the relatively small number of cemeteries or large burial sites. It is evident that the Onondaga region was a "home region," where the Indians resided regularly and where they were accustomed to bury their dead.

SUCCESSIVE OCCUPATION BY DIFFERENT GROUPS (EVIDENCE FROM ARCHAEOLOGY, HISTORY, PLACE-NAMES, LEGENDS)

The Champlain Lowland was successively occupied by different groups of Indians. This is a natural corollary to the fact that as a rule the region was only temporarily occupied. Archaeological evidence bears out this statement. Many sites were occupied more than once and by several groups. The sites have been explored so often by local collectors and by others not scientifically trained in archaeological field methods that the stratification and other evidence which would give us the most complete story have been destroyed. But there is, nevertheless, plenty of evidence to show that the occupations are in many cases "mixed." In general, the western shore and the southern end of the lake show a great predominance of Iroquoian material. At some of these sites, especially those near Lake George, there is considerable evidence of an earlier Algonkian occupation, such as at one time spread over much of New York State. On the eastern shore and throughout the greater part of the region, there is a greater proportion of Algonkian material. The stone implements are in some cases indicative of the particular occupant, though most of them are not to be classified.[6] The material culture of the Iroquois was, in general, superior to that of other tribes, though in many fundamental respects it was the same. The most distinctive of the criteria of Iroquoian occupancy is perhaps the pottery, which shows evidence of finer handiwork than is found on the Algonkian pottery.[7] The site showing the largest occupation in the area, one

[6] Perkins, George H., *Notes on the Archaeology of the Champlain Valley*, p. 205.

[7] See *Report of the Vermont State Geologist*, No. 7 (1909–10), Plate XV, opp. p. 70 ("Vermont Earthenware").

that is more suggestive of Algonkian than Iroquoian origin, though differing from both in many ways, has been located near the mouth of the Missisquoi River (Site 121, see Fig. 3).

The conclusion that the Champlain Lowland was successively occupied by different groups of Indians is clearly borne out by the available historical evidence. It seems certain that during the time

FIG. 3. The site of the ancient Indian burial ground near the Highgate-Swanton town line, Vermont. When sand was taken away for railroad fills, much valuable archaeological material came to light. View northeast from just east of the Central Vermont Railroad, about a mile north of Swanton village.

of which there is any definite historical record, the Abenakis (sometimes called "the Eastern Indians"), of Algonkian stock, were the first and last possessors of the Champlain Valley. For a period at the height of their power (probably from about 1540 to 1640) the Iroquois had control of the area. The early histories of the Iroquois [8] say that they originated in the valley of the St. Lawrence or just to the north of it, and that trouble with Algonkian groups drove them to the region south of Lake Ontario. Here they grew in power and developed their strong confederacy. Spreading

[8] Cusick, D., *Sketches of Ancient History of the Six Nations;* Colden, C., *History of the Five Nations.*

east through the Mohawk Valley, they took in the group of that name as one of the nations. This momentum continued on through the height of the Iroquois supremacy. Expansion proceeded eastward. The Mohegans (or Mohicans) in the upper Hudson, the Hoosac and Batten Kill valleys were reduced to a tributary nation. The power of the Iroquois was acknowledged by one group of the Eastern Indians to extend (within the present state of Massachusetts) to the Connecticut River.[9]

So far, expansion had in effect partly encompassed the Adirondack barrier and it was an easy and logical step to push north to the St. Lawrence and thus gain control of the Champlain highway.[10] The first white man to come up the St. Lawrence (Cartier, 1535) found the Iroquois at Hochelaga (Montreal). Champlain in 1609 apparently takes as an accepted fact the name applied to the River Richelieu (i.e. "the river of the Iroquois"). That he did not find Iroquois Indians at Hochelaga reflects the fluctuating occupation of this highway region. He found the Richelieu River and the shores of Lake Champlain abandoned because of hostilities; he says, for example, that near the Chambly rapids "there are some meadows there where no savages are settled on account of the wars."[11] That the Iroquois power had extended east of the lake is evident from the reply of his Indian companions when he asked whether these lands were inhabited: "They told me that they were — by the Iroquois — and that in these places there were beautiful valleys and open stretches fertile in grain . . ."[12] A

[9] According to the reports of a conference in 1725 between commissioners from Boston and the governor of Canada, a group of Abenaki Indians said that "their land commenced at Long River (the Connecticut) which lies to the west beyond Boston — that this river was formerly the boundary which separated the lands of the Iroquois from those of the Abenakis. . . ." This seems to refer only to that part of the Connecticut River within the present state of Massachusetts.

[10] Other accounts say that the Canienga group of the Iroquois (Mohawks and Oneidas) originally settled at Hochelaga and along the St. Lawrence, that in 1560 a quarrel arose between them and the Algonkians, and that they were driven south along the shores of Lake Champlain and Lake George till they reached the Mohawk Valley. This movement probably preceded their absorption by the main Iroquois confederacy. See Spence, L., *Myths of the North American Indians*, p. 225.

[11] Champlain, Samuel de, *Voyages*, p. 195. [12] *Ibid.*, p. 207.

governor of New York, in referring to a certain map in 1773, said: "All the country belonged to the Five Nations or Iroquois, and as such it is described in the above mentioned and other ancient maps, and particularly is Lake Champlain there called 'Mer des Iroquois'. . . ." [13] The lowland to the east of the lake was known as Irocoisia. At the height of their power, then, "the supremacy of the Iroquois probably prevailed . . . over the territory as far east as the Connecticut River." [14] Several writers speak of Vermont as the Iroquois beaver hunting grounds. But there remained vestiges, traditions probably, of the old Abenaki claim. Although Vetromile speaks of the Abenakis as occupying land from the mouth of the Kennebec to the eastern part of New Hampshire, he upholds the claim embodied in Ducreux's map of 1660 that Lake Champlain is the rightful boundary of the Abenaki territory.[15] The peak of Iroquois extension seems to have been reached about fifty years after Champlain's visit; it may have been checked from further territorial advances by the closing in of English and French settlements. The advent of the Dutch on the Hudson at an earlier date introduced firearms and for a short time stimulated Iroquois expansion.

The Iroquois appear to have voluntarily relinquished their possessions around Lake Champlain and the upper Hudson about 1640 or 1650. There is no direct evidence that this was the case, but it seems certain from the testimony of Ducreux's map and from the fact that in King Philip's War (1675) that chief took refuge in,

[13] Correspondence of Governor Tryon with Lord Dartmouth, a British minister.

[14] DeWitt Clinton in an address before the New York Historical Society in 1825. He says also that the French *voyageurs* usually spoke of Lake Champlain as the "Sea of the Iroquois."

[15] Rev. Eugene Vetromile, "The Abnaki Indians," *Collections of the Maine Historical Society*, 6 (1859): 203–227; "Acadia and Its Aborigines," *ibid.*, 7 (1876) : 337–349; *The Abnakis and Their History* . . . (New York, 1866); and *Indian Good Book . . . for the Benefit of the Penobscot, Passamaquoddy, St. John's, and other tribes of the Abnaki Indians* (1858). These are not listed in the bibliography following this paper.

For many years this man was a missionary and a teacher among the Penobscot tribes of the Abenakis.

Rev. Fr. Ducreux, on a map accompanying his history of Canada (1660), calls the lake "Lacus Champlenius."

and drew many allies (Eastern Indians) from, the region just to the south of Lake Champlain. It is also known that the French and Indians did not meet hostile Iroquois on their journey down the valley to raid Schenectady (1690); nor did they on raids against the New England settlements. It is probable that the ever increasing penetration of the area by the French *voyageurs*, traders and missionaries, and their strong alliance with the Abenakis, together with the growing tendency of the Indians to move westward, motivated a withdrawal on the part of the Iroquois from this peripheral area.[16]

Later, the Algonkians were found more frequently in the valley. Their villages often were associated with the early forts, as Fort St. Anne on Isle la Motte and Fort Frederic on Crown Point. Early settlers occasionally found them occupying parts of the area, especially on the Vermont side. The more important groups were the St. Francis Indians, who came down to the Missisquoi delta from the northeast.

Although the Iroquois were to be found less often in the area, commonly in association with their British allies, their claims to a large part of the lowland were not relinquished for many years. From time to time from 1798 to 1874 the Iroquois chieftains made repeated demands of the Vermont legislature for payment for a large tract of land in western Vermont as follows: "Beginning on the east side of Ticonderoga from thence to the Great Falls (Sutherland Falls) on Otter Creek and continuing the same course to the height of lands that divide the streams between Lake Champlain and the river Connecticut: from thence along the height of land opposite Missisquoi and then down to the Bay." [17] Such a claim made by the Caughnawaga Indians for "long possessed hunting grounds" and signed by twenty chieftains of several tribes, shows the strength of the Iroquois organization. The legislature never allowed this claim, although, curiously

[16] Thompson, D. P., in his *History of Montpelier, Vermont*, gives a helpful discussion of this problem of the occupation of the region. See Appendix, pp. 303–309.

[17] Caverly, A. M., *History of the Town of Pittsford, Vermont*, p. 3; Perkins, G. H., *Report of the Vermont State Geologist* (1909–10), p. 74; Thompson, D. P., *op. cit.*, p. 305.

enough, not upon the grounds that their plea of former occupation was false. The Algonkians claimed that, although the Iroquois did possess this region at the time of Champlain's discovery, the land originally belonged to them and had been taken from them by their enemies.

Interesting evidence of the occupation of the Champlain Lowland is to be found in the character and survival of Indian names and legends. Only fourteen place-names of Indian origin survive today in the area.[18] These are:

1. Bomoseen Lake
2. Bulwagga (?) Bay
3. Hinkum (?) Pond
4. Maquam Bay and Creek
5. Missisquoi River and Bay
6. Moosalamoo Mountain
7. Neshobe Island and River
8. Nicket (mt.)
9. Pico (?) Peak
10. Popasquash Island
11. Queneska Island
12. Saranac River
13. Ticonderoga (town)
14. Winooski River, Falls and Village.

Two of the three on the New York side are of Iroquois origin (12, 13). It is definitely known that the greater number (1, 4, 5, 6, 7, 8, 10, 11, 14) are of Algonkian origin. Most of these are on the Vermont side of the lake. These facts are quite indicative as to the occupancy of the Champlain Valley. If Indian occupation had been less irregular a greater number of Indian place-names would undoubtedly have survived. In Onondaga County, New York, a much smaller area, the topographic maps show exactly the same number of surviving aboriginal names. Of course, many Indian names can be restored; some have come down to us from the descendants of the earlier Indians, some may be obtained from the accounts of early white travelers, and some may be found on early maps. As should be expected, such names in the Champlain Valley are of diverse origin; Iroquois names predominate on the New York side and toward the southern end of the area, and Algonkian names are more common on the Vermont side and toward the north. To the lake itself, to the Saranac and Ausable rivers, to

[18] As shown on the United States Geological Survey topographic sheets. This does not include any territory outside the lake and the adjacent area, which it has been difficult to delimit exactly. Mettawee River, for example, is not included; neither are Taconic and Adirondack, which apply to natural features extending well without the region. In a few cases the Indian origin may be doubtful (marked ?).

Split Rock and other places, two sets of names, one Algonkian and the other Iroquois, can be restored. Such features are mostly on the New York side of the valley, however, and out of perhaps forty names that can be restored in the lowland proper the great majority are of Algonkian origin. In contrast to this, there have been restored for Onondaga County approximately one hundred and ten early place-names, practically all of which are of Iroquois origin.[19] The paucity of local Indian legends tells the same story in regard to the occupation of the area. Although there is a great deal of lore pertaining to the Iroquois and Algonkian groups that came in from other regions, there is almost none that is connected directly with the Champlain Valley. Legends of Iroquois origin are associated with Rogers Slide,[20] the New York shore north of Ticonderoga,[21] Rock Rogeo [22] and Indian Pass,[23] and there are hints of legends connected with Rock Dunder [24] and Bolton Falls [25] on the eastern side of the lake where Algonkian influence was stronger most of the time.

The distribution of sites of occupation is a matter of close environmental adjustment. It is not surprising to find them in protected situations and also denser toward the northern approaches to the valley than elsewhere.[26] They are least common on the exposed shores along the middle section of the lake. Many traces of occupation, particularly arrow-heads, have been found along these shores, but few camp or village sites have been located. On the New York side of this middle section one factor is the rocky

[19] Beauchamp, W. M., *Aboriginal Place Names of New York*, pp. 142–154.

[20] *Ibid.*, p. 237.

[21] *The Jesuit Relations*, 51 : 179–183. Translation of letter by Fr. Mercier, *Burlington Free Press*, August 22, 1902.

[22] Beauchamp, W. M., *op. cit.*, p. 73; Carpenter, W. S., *The Summer Paradise in History*, p. 113.

[23] See Sylvester, N. B., *Historical Sketches of Northern New York . . .*; Street, A. B., *The Indian Pass.*

[24] Crockett, W. H., *Vermont, The Green Mountain State*, 1 : 68; *The Vermonter*, 19 (1914) : 29.

[25] Hemenway, Alby Maria (Ed.), *Vermont Historical Gazetteer.*

[26] The greater number of sites along the northern New York shore (Clinton County) probably is to be attributed in part to the assiduous work of the late D. S. Kellogg, of Plattsburg, New York. Much of the material collected is now in the geological museum at Amherst College, Massachusetts.

and at times inaccessible shore-line. Much of it affords no good camping grounds or sites suitable for villages.[27] The numerous short streams do not penetrate far into the interior. On the broad lowland on the Vermont side the sites are well protected or else are some distance inland. The sites that indicate the use of this area as a highway have already been mentioned (in Chapter I of this study, "Indian Highways"), especially those along the western channel of the lower end of the lake and those along the major tributary valleys. Many of these sites, however, as well as numerous others, were more than mere stopping-places; they were used in the course of hunting, fishing and other activities that involved a somewhat longer stay. This applies in part to the so-called camp sites, but more particularly to the village sites.

GENERAL DENSITY OF DISTRIBUTION OF SITES

In order to visualize this old landscape [28] most effectively, it is best to consider the sites separately or in groups in their environmental setting. This allows us to picture most clearly the activities that were probably carried on by the aborigines.

Two facts are outstanding in regard to the Indian occupation of the area: first, the density of sites along the lake shows that its shores afforded advantageous conditions for occupation; second, although the sites decrease in density away from the lake, the inland sites are important ones, and show a surprising knowledge and penetration of the inland forests and waters, that were so rich in game and fish.

B. Occupation along the Lake Shore

NORTHEASTERN DISTRICT

Of all the lake-shore sections the northern Vermont shore shows evidence of the most extensive and longest occupation in the region. That section of the lake from Colchester Point to the head

[27] Perkins, G. H., "Notes on the Archaeology of the Champlain Valley," *Report of the New York State-Lake Champlain Tercentenary Commission*, p. 250.

[28] This is the crux of such a problem in early historical and late prehistorical geography.

of Missisquoi Bay was very appropriately termed by an early white comer "ye branch of ye lake." [29] A line of islands and a peninsula protect it from the main outlet channel. Many smaller islands serve as "stepping stones" or as isolated camp sites. A number of protected bays are to be found with small streams draining into them, also large areas of sandy soil, especially on the deltas of the Missisquoi and Winooski, and extensive alluvial flats of silty soil. Not far from the lake were moderately rugged hills (the red sand rock group) that gave rise to excellent conditions for hunting and fishing. Here remained comparatively little of the stiff Champlain clay that is so widespread in the less rugged portion of the lowland to the south, something which was always an undesirable, and at times a prohibitive, factor in the location of the Indian settlements.

Missisquoi section

The lower valley and delta of the Missisquoi had many advantages for Indian occupation. It was readily accessible from the St. Lawrence Lowland to the north, from Lake Champlain to the west, and from Lake Memphremagog and vicinity to the east, and at the same time it was in a well-protected situation away from the main channel of the lake. One great attraction for the Indians was the extensive swamp land across the neck of the delta drained by Charcoal, Dead and Maquan creeks. These swamps or marshes were covered (and still are) with a rank growth of willows, whortleberry bushes (or high-bush blueberries), cat-tail flag, bulrushes and coarse grass.[30] Such a situation was of great advantage to the Indian; wild fowl and game were there abundant. An exhaustive study of the place-name "Missisquoi" shows that it is of Abenaki origin and signifies "a grassy or marshy place." [31] The name was applied to Indian villages which existed there as well as to the river and its valley.

This Missisquoi section was now and again extensively occupied

[29] By the Reverend Williams returning with his Indian captors after the Deerfield raid. See Carter, S., *The Route of the French and Indian Army that Sacked Deerfield.*

[30] McAleer, G., *Etymology of Missisquoi*, p. 100. [31] *Ibid.*

by Indians from the earliest times till long after the coming of the white man. The foremost collector of Indian relics in this region has said that "for fifteen miles along the banks of the Missisquoi River, and for one and a half miles back, there is hardly a field but upon which can be found some traces of ancient occupancy." [32] Not only have several village sites been located in this vicinity (Nos. 120, 122, 123, 124), but there probably existed many hamlets or lodge sites such as are indicative of the more enduring occupation of the Iroquois country. If the early local collectors could have covered this region as scientifically as others have since done,[33] there would be even stronger evidence to support this undoubted fact of more regular occupation. The stretch of valley between Swanton Falls and Highgate Falls was the favorite area for settlement. Village sites have been located near each of these portage points.

A site that deserves particular attention is located about one half or three quarters of a mile away from the river, and about two miles north of the village of Swanton, in the southern part of the town of Highgate (Site 121). Here is a large sandy ridge (Fig. 3) that originally was covered with a dense growth of Norway pines. After some of the virgin trees were cut, about 1865 or 1866, heavy winds from Lake Champlain exposed to view stone implements buried beneath the larger remaining trees and the half-decayed stumps. Then digging was resorted to and between twenty-five and thirty-five graves were discovered. Some of these were as much as six feet below the surface; later the winds entirely uncovered others.[34] The survivors of the St. Francis tribe who lived in the vicinity for many years after the coming of the white settlers had no knowledge of this ancient cemetery, not even a tradition that hinted of its existence.[35] We may feel sure that these graves,

[32] Truax, L. B., *Indian Occupation and Relics*, p. 29.

[33] In addition to the extensive work of L. B. Truax, of St. Albans, and G. H. Perkins, of the University of Vermont, Warren K. Moorehead and others spent some time in the area in an archaeological survey in the summer of 1917.

[34] Perkins, G. H., *Ancient Burial Ground in Swanton*, p. 76; Moorehead, W. K., *Archaeology of Maine*, p. 245.

[35] Perry, J. B., *Proceedings of the Boston Society of Natural History*, 12 (1868–69) : 220.

located as they were beneath huge pines, were dug many years, perhaps several centuries, ago.

The evidence shows that this graveyard belonged to a people with a culture somewhat different from that of either the Algonkians or the Iroquois as the white men found their cultures. Most of the implements found are of finer material, and some are of a different shape and more elaborately wrought than those of later groups. The association of prehistoric copper objects and of early problematical stone objects with stone tubes [36] and iron nodules has given rise to an important problem in New England archaeology. The culture here represented is of a high order and of great antiquity. It marks a departure from the early Red Paint People culture of Maine.[37] It more closely resembles Algonkian than Iroquoian culture. It has been thought that these Indians might have been a branch of the mound-building race that wandered eastward from the main group of that type, some perhaps following the St. Lawrence and finding their way to the Missisquoi River. Some similarity in culture, as well as the fact that this was an isolated group of graves, suggests that a few of these people may have found a temporary residence here. Because of the light soil and the possibility of their removal by the strong winds,[38] the absence of mounds does not prove that none ever existed there.

A much more recent burial site has been located near the river about two miles below the falls on a sandy terrace of considerable thickness resting on underlying clay. At high water bones have been washed out of the banks and numerous stone implements have been found on the ground and in the graves. Although it is known that this was used as a place for the interment of the dead at a comparatively recent date by St. Francis Indians living in the vicinity, there is considerable evidence to indicate that some of the graves were of considerable antiquity.[39]

After the coming of Champlain and with the increasing French occupation of the St. Lawrence Valley the Iroquois apparently

[36] See, for example, *American Anthropologist*, New Ser., Vol. 13 (1911), Plate XVII, opp. p. 242.

[37] It shows no gouges, adze blades, long slate spears or plummet effigies.

[38] Perkins, G. H., *op. cit.*, p. 7.

[39] Perry, J. B., *Hemenway Gazetteer*, 4 : 944–945, *s. v.* "Swanton."

retired from the Champlain Lowland and the Abenaki Indians made more frequent visits to the Missisquoi section. There is a record that there were Abenaki Indians at Missisquoi in 1650.[40] Two miles beyond the lower falls of the Missisquoi was an Indian settlement of fifty or more wigwams known as "Missisquoi." Another record speaks of the Abenakis as appearing on Lake Champlain (1690) after they had been driven from Maine by the English in 1680, where they were given grants by the Governor of Canada.[41] A confirmation of this settlement speaks of the village as a "large Indian town." [42] Relatively little is known about the movements of these groups and the routes they followed. The Coosucks in the upper Connecticut Valley, the Indians at Missisquoi and those on the south bank of the St. Lawrence, all of Abenaki stock, sustained close relations with one another, and, with the growing influence of the French traders and Jesuits, came to be commonly known as the St. Francis Indians.

Their occupation of the lower Missisquoi Valley was by no means permanent, however, fluctuating as it did with the varying fortunes of war and the exigencies of their nomadic life. After the seizure of Lake Champlain by the English (1760), many of the Abenakis, who were often allied with the French, began to retire gradually to Canada. They lingered longer, however, in the vicinity of the Missisquoi than elsewhere. It made a good base of operations for Greylock in connection with his raids against the English colonists.[43] When the early settlers came, the Indians still claimed ownership of this section and caused early travelers considerable trouble by burning and destroying property. After the close of the War of Independence many more Indians withdrew to Canada because their sympathies, like those of so many others, were with the British rather than with the Americans. The com-

[40] Perry, J. B., *op. cit.*, p. 219.

[41] *History of the Catholic Church in the United States*, p. 581. The grants extended "from the river Chaudière on the St. Laurent to the River Richelieu and Lake Champlain." The Rivière Chaudière flows from the south into the St. Lawrence just above Quebec city.

[42] Allen, Ira, *The Natural and Political History of the State of Vermont*, p. 15.

[43] Crockett, W. H., *Vermont, the Green Mountain State*, I, chapter on "Greylock."

ing of many Protestant settlers was another factor in the withdrawal of the Indians, who had strong Jesuit affiliations. When the first of these white settlers came, the Indian village and a Jesuit chapel were still in existence. It is even said that the Indians removed their sanctuary with them, transporting the stones and bell in their bark canoes. The wigwams of the Indians were located on the east side of the river at Swanton Falls. In 1793 there were about seventy Indians residing there. That they continued to visit this region for some time is shown by the record of four or five Indians families who came about the year 1825 and settled about one-half mile below the village.[44] Here they stayed about a year, obtaining their living by hunting, fishing and basket making. They continued to put forth a claim to the lands, as the Indians had done from the first.[45]

Sheltered bays (type, Malletts Bay), islands, other sites

Of the numerous sheltered bays of the northeastern section of the lake that were occupied, Malletts Bay illustrates the admirable manner in which the Indian so often utilized to the maximum the advantages of his environment. This bay afforded excellent protection from storms or enemies and was located near to what must have been excellent hunting and fishing grounds. It is some two miles across in any direction and is landlocked except for the half-mile opening out to the main lake between Malletts Head and Red Rock Point. Hills rising to more than 200 feet above the lake surface (which is 95 feet above sea-level) make the bay even less visible from the lake. Flowing into the bay on the northeastern shore is Malletts Creek. The lower half mile of its course, up to the mouth of Indian Brook, is an estuary that at high water in spring and summer is in reality a small cove with a restricted entrance formed by wooded ridges. It could be easily approached by either dugout or canoe, and could not be seen from the lake nor from the bay until approached closely. In the lower course of Malletts Creek and its tributaries — Indian, Allen, and Pond brooks, all

[44] On land then owned by Rufus L. Barney.
[45] Perry, J. B., *Hemenway Gazetteer*, 4 : 1001, *s. v.* "Swanton."

of which join not far from the lake — are extensive areas of swamp land, such as so often played an important part in the hunting operations of the Indians. Today these areas still abound in cattails and muskrats.

The Malletts Bay locality is probably the site of a long-occupied camp. The bank in which the implements were found was mostly of a stiff clay, a large part of which is under water when the lake is high. One of the more extensive and important finds of bone utensils of the whole valley was made at this site.[46] In addition, there were numerous scattered bones of bear, deer, elk (moose), wolf, beaver and other animals.[47] Some of the earthenware that has been found is suggestive of Iroquoian origin.[48]

A glance at the list of objects from or near this site in the Burlington Museum attests the character of the occupation and the activities that were carried on.[49] This list affords abundant evidence of hunting and fishing carried on not only in proximity to the lake, but undoubtedly also well inland where it is hilly and the streams are numerous. Colchester Pond, near the first prominent ridge of the Red Sandrock Hills, surely would have provided good fishing.

There are other sheltered bay sites along this protected area of the lake, which show that such situations were much favored by

[46] See *Report of Vermont State Geologist*, No. 7 (1909–10), Plate XVII (Vermont Bone Implements), opp. p. 72.

[47] This area was carefully searched by Mr. W. D. Griffin and most of the collecting was done by him.

[48] Notes on the Malletts Bay site appear in G. H. Perkins, "Aboriginal Remains in the Champlain Valley," *American Anthropologist*, 11 (1909) : 615.

[49] Seventeen hammerstones, seven knives, four rubbing stones, three celts, one gouge, one stone mortar, one drill, three net sinkers (Malletts Creek), other rude stone implements, pieces of bowl, fragments of marked pottery, seven pipes, five fragments of stem of earthenware pipe, one deerskin worker, fifteen bone awls (some of them split awls), two bone pottery markers, nine pieces of worked bone, two deer horns worked, one bone spear, one serrated bone spear, two beaver teeth, beaver incisors, split and polished canine tooth, two bear teeth, stag horn, bones of deer, jaw bone of deer, antlers, vertebrae and axis of deer, six types of deerhorn (bone awls), lower jaws of bear, beaver and deer, lower jaw and cranium of human.

Chapter III of this study deals in detail with the various activities of the Indians in the valley, especially as they can be interpreted from their implements.

the Indians. There are two camp sites or village sites in the vicinity of Highgate Springs along the shore of the southeastern portion of Missisquoi Bay (Goose Bay), a shore that is protected by the northward projection of the Missisquoi delta. Both these sites are located near the mouths of small streams and near inland swamp areas. Site 123 is near Dead Creek and Site 124 is near Rock River. Likewise, two sites are to be found along the shore of St. Albans Bay, Site 119, on a rise of ground just east of the marshy outlet of Stevens Brook, at the head of the bay, and Site 118, near the outlet of Mill River, on the eastern shore.

The islands of Grand Isle County, which serve so well to cut off this northeastern portion of the lake, were used by the Indians who occupied this area. The importance of "The Carrying Place" and the small islands of the channel (e.g. Butlers Island and Savage Island) have been mentioned in connection with the use of the lake as a highway (Chapter I of this study). Although one writer claims that "there is probably not a form in Grand Isle County [50] but will show some evidence of ancient occupation," [51] it is probable that, during the later Abenaki occupation at least, the mainland settlements were the most extensive and enduring. The occupation of the islands was largely incidental to the periodical movements of the Indians to and from the east and north. And so we find important sites on two of the three points of the islands where they approach nearest to the mainland.

At East Alburg, just south of the crest of what is known locally as Fox Hill, there have been found remains of Indian occupancy (Site 116). Deposits of chippings, pottery fragments and firestones are good evidence of a village site.[52] During the construction of the railroad just to the south, much sand and gravel were taken from here, and Indian graves and other proofs of occupation were exposed to view. Numerous traces of activity have been found near West Swanton and on other parts of Hog Island,

[50] Grand Isle County, Vermont, comprises the Alburg Peninsula, North Hero Island, Isle la Motte, Grand Isle or South Hero Island and several smaller islands.

[51] Truax, L. B., *op. cit.*

[52] Truax, L. B., *op. cit.*, p. 26. These were found at a depth varying from one and one-half to three feet.

directly opposite. These include a "nest" of knives of stone,[53] and a hamlet or camp site on the farm of A. Niles.[54]

Again, farther south at the Sand Bar and at the mouth of the Lamoille River opposite, there is historical evidence of the presence of Indians. Grand Isle was occupied by the St. Francis Indians for many years after the first settlements were made by the whites in Chittenden County, Vermont (i.e. the Vermont mainland opposite Grand Isle County).[55] A branch of the Abenakis, called locally "Zoquageers," had a village in the town of Alburg. Another group or some of this same tribe known as the Loups (or Wolf-tribe) are said to have resided at the Sand Bar in South Hero, though they departed from that place before any settlement by the whites.[56] It is known, too, that they lingered at the mouth of the Lamoille for some time after settlements were begun.[57] A branch of the Iroquois, with the aboriginal name Notsiione, at one time drove back the Zoquageers.

The environmental conditions of the islands were such as to invite Indian occupation. The original forests were of pine and oak, with large numbers of cedars and tamaracks (especially in the swamps) and also with some hemlock, basswood, beech, birch, elm, maple, walnut and butternut.[58] These forests harbored an abundance of game and furnished material for food and utensils. There were extensive areas of swamp land along the lower parts of the islands and their small streams, which accentuated the barrier character of the islands in addition to furnishing good hunting grounds. The swamps at the mouth of the Lamoille probably played as definite a part in the life of the natives as did those at Missisquoi.

Such was the character of the aboriginal occupation of this northeastern section of the Champlain Lowland. Because of its

[53] Acquisition numbers 2717–2727 in the Burlington collection.

[54] Fire-bed, fragments of pottery and implements found. — Truax, L. B., *op. cit.*, 25.

[55] Thayer, L., *Hemenway Gazetteer*, 1 : 859, *s. v.* "Shelburne."

[56] Dixon, D. W., *Hemenway Gazetteer*, 2 : 473, *s. v.* "Grand Isle"; Hoskins, N., *History of the State of Vermont*, pp. 3–4. Site 110.

[57] Crockett, W. C., *op. cit.*, p. 58.

[58] Dixon, D. W., *op. cit.*, 517–18; Hill, I., *Hemenway Gazetteer*, 2 : 555, *s. v.* "Isle la Motte."

protection, its location near the St. Lawrence country and other favorable natural conditions, this area was characterized by more consistent occupation, particularly by Indians of Algonkian stock, than any other part of the lowland. We find Algonkian settlements and activities at Missisquoi and when conditions were favorable they spread out to other sections of the valley. The accounts of the early Jesuits who followed Champlain give interesting indication of the location of the settlements and the character of the occupation. The first missionary came in 1615 with an escort of Indians in two bark canoes. After spending some time at Isle la Motte, he visited scattered bands of hunters who were encamped along the eastern shore of the lake and at other points in the vicinity. A flourishing encampment was found at the first falls (Swanton) of the Missisquoi to which the party navigated. They then journeyed on foot to visit other groups near the base of some hills (probably those east of St. Albans). They went by Indian trails to visit other groups on the banks of the Lamoille and later by canoe to settlements on the Winooski. By the end of their three months' stay they had traversed the eastern border of the lake to the last encampment near its southern extremity.[59] This, however, was merely a summer camp, as the nearness of the Iroquois "made it unsafe to remain there longer than through that portion of the season when the Mohawks and their confederates were busy with their own pursuits among the hills of the Adirondacks." At the end of the season, when the camp was broken up, its inhabitants returned to Winooski. Grand Isle is described as a favorite annual resort of the natives for the period during which they are safe from the incursions of foes.[60]

NORTHWESTERN DISTRICT

The character of the occupation along the western channel of the lower lake is somewhat in contrast with the eastern area just considered. The camp sites that are, or that may be, indicative

[59] Probably just south of Split Rock Point near the mouth of Big Otter Creek or Little Otter Creek. In the minds of these people the end of the lake might well have been this important constriction. It is probable, too, that the Shelburne Bay site was occupied by these groups (Site 101).

[60] *Catholic World*, 22 (1875) : 277–281.

of the highway character of this channel have already been noted (Chapter I). Although there was much less regular occupation of this part of the lowland there was an environment favorable for Indian activities. There are sites which indicate that this section was used when well under the control of one group or another, although, to judge from the implements found, more often by the Iroquois.

Isle la Motte

The north end of Isle la Motte was a favorite place for Indian occupation. Its position just south of the outlet of the lake in the middle of the channel made this a convenient stopping-place and frontier point for the Abenakis from the north and east. Champlain speaks of this as one of the "beautiful islands," but because of hostilities he found no Indians there.[61] It is said that the first missionary stopped for a day or two on the island.[62] It is interesting to note that half a century later, with the advance of French influence from the north, a frontier fort and settlement were placed here (Fort St. Anne near Site 8), a locality which it is certainly safe to assume was a rallying place for their Indian allies.

Excavations near this spot [63] indicate that this is, with the possible exception of Colchester Point, the largest single site on Lake Champlain. Much broken pottery has been discovered in the sandy soil at a depth ranging from ten centimeters to a meter. In the upper layers the pottery was predominantly later Algonkian rather than Iroquoian in character; the lower layers contained fragments of the archaic Algonkian form.[64] A burial site is reported on the Hayden property on the northern point of Isle la Motte (Reynolds Point), not far from the shrine (Site 7). Here, when material was scraped off the top of a rise on the sandy bluff for the construction of a house, implements, beads, human bones and various other indications of aboriginal occupation were found.

[61] Champlain, S. de, *Voyages*, p. 205.
[62] *Catholic World*, 22 (1875) : 277.
[63] Now marked by a Catholic shrine.
[64] Moorehead, W. K., *op. cit.*, p. 243.

Plattsburg section

The section near Plattsburg, at the head of Cumberland Bay, was the site of important occupation. The greater number of implements found here on the New York side of the lake are of Iroquois origin and it would appear that these people used this site more than did Algonkian groups. This section presents a number of environmental advantages. The bay is well protected by Cumberland Head, and it is in effect a junction between the main lake route and the Saranac River route. Flowing into the head of the bay is a fair-sized, sluggish stream (Dead Creek), bordered by swamps and abounding in fish. The entrance to the creek is somewhat constricted by sand bars. Between this creek and the bay was a sand ridge a mile long, from twenty to forty rods wide, and from fifteen to twenty-five feet high. When some of the original pines were cut off and the northerly and southerly winds made trenches through the ridge at right angles to its length, it was seen that here was once a great Indian village, or, more accurately, a series of village sites (Site 21). With later digging vast quantities of arrow and spear points, flint chippings, beads, knives, celts, scrapers, hammers and whetstones were found. Portions of the rims of more than eight hundred *different* vessels were unearthed at this site, the rather elaborate workmanship and ornamentation of which showed that most of them were of Iroquois origin. In addition to small fireplaces formed by fire-blackened cobblestones, with a few remains of charcoal in some places, there were regular kitchen middens, containing broken bones of mammals, bones of fishes and birds, stone implements, fragments of pottery, pot-boiling stones that had been heated by fire, clam shells and much refuse material.[65] This site was apparently not entirely prehistoric. The Iroquois who held Peter Esprit Radisson captive in 1652 "arrived to a fine sandy bancke, where not long before Cabbanes weare erected where Prisoners were tyed." [66] The grayish white sand of this ridge was visible for miles out on the bay and lake.

[65] Kellogg, D. S., "Aboriginal Dwelling Sites in the Champlain Valley," *Proceedings of Vermont Historical Society*, p. 309; also "Early Mention of Events and Places in the Valley of Lake Champlain," *ibid.*, p. 58.

[66] Radisson, P. E., *Voyages*, p. 35.

There are other sites in the vicinity that may well have been associated with this one or at least which have taken some advantage of this location. Camp site 20 is on the bay at the eastern end of this sandy stretch. Site 16 (probably two village sites) is located on a sandy rise of ground east of the main stream of Dead Creek, some distance inland from the bay near the north line of the town of Plattsburg. Sites at East Beekmanton (Site 15), near Woodruff Pond, as well as those on the Saranac River, may well have been associated one with another.

It is probable that the sites on Point au Fer were used at times for more than transient occupation by the Indians. The five village sites along Kings Bay (Site 10*a*), those on Point au Fer (Sites 5*A* and 5*b*), others at the mouth of the Great Chazy (Site 10), and that on the bank of the river opposite the mouth of Corbeau Creek (Site 4) all have much the same type of location as those near Cumberland Bay.

The protecting peninsula, the river flowing into the bay, the small tributary stream at the head of the bay, and the swamp land across the neck of the peninsula are similar in each case, and make these two groups of sites on Kings Bay and on Cumberland Bay very comparable.

Other Sites

There are numerous other sites along the northern New York shore that probably were at times occupied for purposes of hunting and fishing. These include a village site north of Rouses Point (Site 2), one near the north line of Chazy and north of the Little Chazy River (Site 6), another on the flats near the mouth of the Little Chazy (Site 9), and a village on the sandy north shore of Treadwell's Bay (Site 13). Some of the various camp sites, farther to the south, mentioned in Chapter I, may have been used for hunting and fishing. The sites in and around the mouth of the Ausable show evidence of such activities rather well. There are five camp sites in this vicinity, one near the mouth of the Little Ausable (Site 33), one on the end of Ausable Point (Site 34), and three smaller ones between this and Bagg's Point on the Ausable (Sites 35 to 37). The little Ausable and the several distributaries

of the Ausable (including still another "Dead Creek") drain through a large area of swamp land. Although we know that Ausable Point was an easily accessible stopping-place and that on occasion such swampy places served as convenient and protective cover,[67] the location of several smaller sites farther from the lake would suggest penetration of this area for hunting and fishing. The presence of Ausable Chasm not far from the lake probably precluded the use of the sites on the Ausable as stopping-places on a tributary route.

Such was the occupation of the western channel and western shores of the northern part of the lake, an occupation at times very temporary because of the highway character of the channel, but one which at other times enjoyed a favorable environment for certain activities, especially to the Iroquois from the south and west.[68] Although more open to danger from enemies and affording a hilly country with considerable tracts of sandy and gravelly soil and many swampy places along its shore-line.

MIDDLE DISTRICT

New York shore

The occupation along the shores of the middle portion of the lake was sparse, sparser in fact than in any other part of the lowland. South of Trembleau Mountain the New York shore-line is much less inviting to the long-staying camper than it is to the north. Throughout the length of Essex County the Adirondacks approach close to the lake, and access to the interior is generally difficult. Traces of occupation have been reported along the shore

[67] Radisson says: "In the night we heard some shooting, which made them [his Indian companions] embark themselves speedily. In the meanwhile they made me lay down whilst they rowed very hard. I slept securely till the morning, where I found myself in great high rushes. There they stayed without noise" (*Voyages*, p. 36). Although this may have been at the mouth of the Lamoille, it is more probable that it was at the mouth of the Ausable.

[68] Algonkian names for points on the New York side show that the Algonkian Indians were familiar with that shore and probably inhabited it at times. Thus the Saranac River was known as Senhalenactuk, "the river of sumach trees," and the Ausable as Popoquamaneetuk, "the cranberry river" (certainly such a swampy place would be an excellent habitat for cranberries.)

of Willsboro Bay opposite the tip of Willsboro Point (Indian Bay, Site 135), along the shore below the mouth of the Bouquet River in Willsboro (Site 134), and along the shore south of the village of Essex (Site 136). The Bouquet River flows parallel to the lake some three or four miles inland for seven or eight miles north of Split Rock Mountain. This strip of land is less rugged than neighboring lands and affords better conditions for occupation. Site 44 is situated on a sandy stretch near Westport in another less rugged piece of country south of Split Rock Mountain. This situation also obtains north of Crown Point and opposite Five-mile Point in the vicinity of the outlet stream of Worcester Pond, about four miles north of Ticonderoga, where the Adirondack ranges begin to draw away from the lake again. Captain John Schuyler, in an account of his early voyage down the lake (accompanied by the Iroquois), calls a place some miles north of Crown Point by the name of Kanondoro.[69] This probably refers to the section north of Split Rock.[70]

Vermont side of lake (Shelburne Bay, Ferrisburg section, Addison County section)

The Vermont shore from the Winooski to the mouth of the Otter afforded several good sites that were more than temporarily occupied, especially by the Abenaki Indians. These Indians advanced up the lake from the Missisquoi and the Winooski at times when they were in control of the lake or whenever it was safe for them to do so. Village sites have been located on the lake shore, principally at the mouths of rivers and streams which afford access to hunting and fishing grounds on the broad lowland that spreads out from the lake to the Green Mountain range.

Shelburne Bay is well protected against approach, especially from the south, and we find that this section was occupied by the Canadian Algonkians. Shelburne Point was known as Quineskatook, meaning "long joint," as it was supposed to resemble a man's forearm. The La Platte River flowing in at the head of the bay

[69] *Proceedings New Jersey Historical Society*, 1 : 72.
[70] Beauchamp, W. M., *Aboriginal Place Names*, p. 71.

appears on one old map as the Quineska.[71] On the flats just east of the mouth of the river the early settlers found interesting evidences of aboriginal occupation (Site 101). A square field of about twenty-five acres had been cleared and apparently cultivated for some time, for there were no stumps of the original timber. There was, however, a heavy growth on all sides, and two large trees stood in the area. At the time of discovery it was covered with a thick growth of small trees unlike the surrounding timber (perhaps second-growth gray birch or poplar). The age of these trees was not over thirty years, and, since the settlers first came to Shelburne about 1766, the cleared tract had evidently been abandoned before 1735. When the land was again cleared by whites considerable quantities of Indian implements were found. There were numerous heaps or small piles of stones that must have been carried there,[72] probably for camp fireplaces. Along the lake shore there were also other places where the natives apparently had camped for a short while.

Several sites have been located near the mouths of the streams that flow into the lake within the limits of the town of Ferrisburg, Vermont. There are two village sites (91, 92) on sandy-loam soil on the north bank of Lewis Creek, or, as the Abenakis very appropriately called it, Sungahneetook, "Fish-weir River." In addition, there is much marshy land along the lower course of this stream, as well as along the Wonaketookese, or Little Otter Creek, just to the south.[73] Site 87, near Fort Cassin Point [74] at the mouth of the Big Otter Creek, has very similar environmental advantages.

[71] Crockett, W. H., *op. cit.*, 1 : 68. Southier's map, 1779. This name survives today, being applied to an island off the west shore of Shelburne Point.

[72] *Ibid.*, 1 : 59–60; also Thayer, L., *op. cit.*, *Hemenway Gazetteer*, 1 : 859. The soil here is clay and contains no stones. They may have been brought from outcropping ledges near by or from the limestone bluffs along Shelburne Point.

[73] Robinson, R., *Hemenway Gazetteer*, 1 : 31–32, *s.v.* "Ferrisburg"; also Moorehead, W. K., *op. cit.*, p. 245; map, p. 253.

[74] Many implements have been picked up at Fort Cassin Point (Swift, S., *History of the Town of Middlebury . . .*, pp. 40–41).

Addison County section

The stretch of shore-line from the mouth of the Otter to Larrabees Point does not appear to have been extensively occupied by the Indians. Numerous relics have been collected along the lake shore of Addison County,[75] which indicates that the Indians made visits there or stopped in passing, but no important sites are reported. Aside from the fact that it was often "neutral ground" between the two great groups, there are several unfavorable environmental factors that may be cited. First, although the shore-line is a lowland, there are relatively protected bays. There are few streams flowing into the lake from this strip of country. This almost flat, western part of Addison County, up to the ridge of Snake Mountain, is very deficient in water supply (especially the towns of Bridport, Addison and Panton). A glance at a drainage map brings out the contrast between the Vermont and the New York shores in this respect. Living water from springs is exceedingly scanty, and there was a minimum number of camping places. The sluggish Dead Creek and its tributaries, highly impregnated with salts, drain most of this area. Although bordered by marsh land for ten or twelve miles of its length, we find not a single site reported. Before the white settlement of the country the few springs were visited by deer that were attracted by the salt, and it is probable that the natives did more or less hunting in the original forests of pine, oak, soft maple and black ash, although they stayed but a short while.[76] The prevailing type of soil throughout this whole section is a stiff clay that practically prohibited any primitive agriculture.[77]

[75] A considerable number of implements, including 25 points and 16 knives, from this shore are in the Burlington Museum, donated by collectors, who have made this region a specialty.

[76] Swift, S., *op. cit.*, pp. 10–11.

[77] See Wilder, H. J., and Belden, H. L., *Soil Survey of the Vergennes Area, Vermont–New York.*

SOUTHERN DISTRICT

Upper stretch of Lake Champlain; Lake George

The occupation of the New York side of the middle portion of the Champlain valley was by the Iroquois and that of the Vermont side was by Abenakis. When the Iroquois were in control of the lowland the Abenakis retired toward the north, and Iroquois settlements penetrated down to and beyond the Winooski. At other times the Abenakis extended their settlements over on the New York side and well up the lake. When the French established Fort Frederic on Crown Point, this was a great rallying place for the Abenakis and their Indian allies. If the archaeological evidence were more nearly complete, it is probable that we should find that the archaic Algonkian occupation had spread over the whole region many years prior to the advent of the Iroquois and Algonkian cultures as the white man found them.

The rugged shores and the narrowness of the waterway accentuated the highway character of the upper end of the lake south of Ticonderoga and discouraged anything but temporary camp sites. There are, however, two or three places where there was, or may have been, occupation of longer duration. Numerous traces have been found along the constriction south of Ticonderoga formed by Wright Point and Chipmans Point.[78] The conditions for hunting and fishing here were probably much more favorable than just to the north, where Mts. Defiance and Independence crowd close to the lake. Again, numerous traces of occupation, including a Mohawk encampment (Site 54), have been found just south of Mill Bay. Mill Brook, flowing into the little bay, is bordered by swamps in its lower course and heads back into a fair-sized valley.

Indian occupation of Lake George and its shores is considered in this study only so far as it indicates the use of the lake as a tributary trail to the main trunk-line of Lake Champlain. Physiographically Lake George is quite out of the lowland area. Its occupation, too, was predominantly by the Iroquois, although at

[78] Kellogg, D. S., *Early Mention of Events and Places . . .*, p. 61.

times French and Algonkian groups passed along the lake. The Wood Creek route, however, seems to have been more frequently used by these groups. The sites about the lake, as well as those in the vicinity of Halfway Brook (58–62), show evidence of Iroquois occupation with underlying traces of an older occupation by the early Algonkian culture.

IMPORTANCE OF FOCAL POINTS

Mention has already been made (Chapter I) of focal points, or junction points, and of their importance in connection with the highways. At or near practically all such points we find evidence of settlements, in most places of more than transient character. Such spots not only afforded convenient stopping-places for parties in through travel, trade or warfare, but also served as natural "stepping-stones" in the aboriginal penetration to the inland hunting and fishing grounds. About these places there were, too, many natural conditions of which advantage could be taken. It might almost be said that all the more important and more extensive sites are to be found at just such places. This would not be strictly true if only the focal points of main or through routes were considered, but when we take account of the various activities of the Indians and understand that their trails went almost everywhere following even the smallest streams, it is easier to appreciate the importance of junction sites. It is also easier, then, to appreciate the fact that more than half of the listed sites are located at or near hydrographic outlet points.

The character of the occupation at a number of the main focal points has been considered in another connection (Chapter I): Missisquoi (site of Swanton), Cumberland Bay (site of Plattsburg), the mouth of Otter Creek (Vergennes at lower falls), the junction of the Mettawee and Poultney rivers and Wood Creek (site of Whitehall), the upper forks of the Winooski (site of Montpelier), the junction of the Castleton and Otter valleys (site of Rutland). Among the other more important focal points were the mouth of the Winooski (site of Burlington) and the outlet of Lake George (site of Ticonderoga). It is interesting to note that today the more populous cities and towns of the region are located at or near

these same points. Another focal area was that part of the lake near Kings Bay and the north end of Isle la Motte. This was on the main lake highway not far from its outlet, with the Great Chazy flowing into Kings Bay and the route to Missisquoi branching around or across the Alburg peninsula.

Colchester Point and the lower valley of the Winooski River

The importance of Colchester Point and the lower valley of the Winooski has been stressed a number of times in earlier connections. Settlement was denser here on the sandy stretches of "pine plains" and at Missisquoi than elsewhere in the region. The Winooski sector, however, had a more exposed location, nearer the Iroquois country; hence we find that Algonkian settlement there was much more intermittent, whereas at times Iroquois occupation was rather strong. It was more of an outpost for the Algonkian Indians.

It is significant that at that place there was found what possibly marks the largest site upon Lake Champlain. Here, on the large, prominent point northwest of Burlington, on sandy soil originally covered with turf and a growth of white pine, was the site of an Indian village which extended for about five hundred meters. Four or five different types of stone used by the Indians were found, and the ground was literally covered with thousands of small and large flakes, burnt stone, etc. Pottery, however, was not common. Twenty-five spearheads and arrow-heads were found in one compact "cache." [79]

The whole lower valley of the Winooski was one of the areas of denser Indian settlement. From Colchester Point to Williston, at least, the soil has yielded many celts, chippings, and wrought flints.[80] Here, as at Missisquoi, it is impossible to reconstruct the whole evidence. On the "intervals" at Burlington the early American settlers found several hundred acres, for the most part in a single tract, that had been entirely cleared, level lands over which the stream freshets periodically deposited silt. At one time when the river washed away its bank opposite Burlington, bones

[79] Moorehead, W. K., *op. cit.*, p. 243. [80] Kellogg, D. S., *op. cit.*, p. 59.

of various sorts and sizes were brought to light along a strip more than ten rods in extent. The horns of deer could be distinguished.[81]

Ticonderoga section

The site of Ticonderoga also was a focal point of major importance in the Indian occupation of the region. It occupies a position on the western shore of the upper lake somewhat analogous to that of the site of Burlington on the eastern shore of the lower lake. We find that Iroquois occupation predominated at Ticonderoga and that it frequently was an advance post for the Iroquois, just as the mouth of the Winooski was for the Abenakis. Camp sites indicated by arrow-heads, pestles, mortars, chisels, gouges, knives, axes and pottery occur in the northern part of Ticonderoga, "along the flats of Trout Brook, and especially near the rapids at the head of the outlet." [82] More recent articles were also abundant.

C. Penetration Inland

The Indians penetrated beyond the lake shore in quest of game and fish to favorable locations in the remotest parts of the region. Rugged lands with numerous small streams and the inland ponds and swamps were favorite places. Although the lake formed a natural and much-used means of access to such areas, yet they were at times approached from other directions. This was particularly true on the New York side, where most of the inland ponds are some distance from the lake and so tended to be more easily accessible for the Iroquois from the south and west.

Importance of hydrographic focal areas

To illustrate the importance of hydrographic focal areas one writer, in tracing out the route of a group of Algonkian Indians on a hunting expedition inland from the shore of the lake north of the Lamoille, says: "Here about midway between the east and west boundaries of Fairfax and within a radius of about a mile and a half are the headwaters of half a dozen streams, flowing south, north and westerly. This region and its approaches serve to

[81] Sanders, D. C., *A History of the Indian Wars . . .*, pp. 104–105.
[82] Smith, H. P., *History of Essex County*, p. 381.

illustrate the methods and habits of the Indians, whether considered as residents of such a region, or as on a hunting excursion, or simply as making an incidental detour in quest of game for temporary provision on a journey." [83]

The Snake Mountain ridge is an example of a larger area where this adjustment to a hydrographic form was made. This ridge with its southward extension (high points are Hemingway Hill, Mutton Hill, etc.) parallels the Lemon Fair River on the west and cuts it off from the western part of Addison County. To the east the Lemon Fair is paralleled in its lower course by "The Ledge," near the Cornwall-Weybridge line, and by other lesser ridges. In addition to Site 84, at the junction of the Lemon Fair and Otter Creek, numerous evidences of occupation have been found along the Lemon Fair and its tributaries, showing that this area was quite extensively used for hunting and fishing purposes. Abundant traces of occupation, including the usual implements and places designated for fires in the Indian huts,[84] have been noted near springs and along the flats near the Lemon Fair. Likewise, in Cornwall were found the foundations of an old Indian hut, and, at many of the springs, pavements designed and used for fireplaces. One reason for these pavements may have been the prevalence of clay soil, which is very miry when wet. Where a fire was made at all regularly, it is probable that there would be a little turf or leaf-cover to prevent mud from being worked. Speaking of the location of these hearths one historian says: "These are always on the borders of the Fair, or of brooks running from the hills into it." [85] Other sites have been located on comparatively high ground where the soil is more loamy in character, as near Beaver Brook in Cornwall.

Many other similar attractive localities on the New York side, as well as on the Vermont side, might be mentioned. The site on the upper La Platte (95), and the evidence along New Haven River, Middlebury River, and other eastern tributaries of the Otter, illustrate the general tendency.

[83] Carter, S., *op. cit.*, p. 141.
[84] Swift, S., *op. cit.*, pp. 37–38.
[85] *Ibid.*, p. 37.

SIGNIFICANCE OF INLAND SWAMPS

The inland swamps, as well as the shore-line swamps, played a part in the aboriginal occupation. Apart from some of the swamp lands bordering certain of the inland ponds, the largest sections of swamp occur north of the Saranac River, on the New York side, and on the broad lowland of the Vermont side south of the Winooski, especially along the course of Otter Creek. Sites have been reported at "Fields Island" in Brandon, and at least two sites near Cedar Swamp, the largest single swamp in the region, in Cornwall near the Salisbury line. Traces of occupation in Cornwall on higher ground may well have been associated with the use of this swamp. In Salisbury, in the midst of a dense cedar swamp a long distance from any hard land, was found a spring that had been logged up by the Indians. It was in a triangular form and was sufficiently large to admit a small pail or bucket.[86]

ATTRACTION OF INLAND PONDS

The gems of all the inland hunting and fishing grounds were the numerous inland ponds. Early records show that these ponds, with the associated swamps, streams and forests, abounded in fish or game. Numerous good-sized village sites near these ponds, many of them near the outlets of the ponds, are evidence of the use which the Indians made of these sections at certain times.

Woodruff Pond, at the neck of Cumberland Bay, is an example of a pond very close to the lake that was frequented by the Indians. Associated with it is a considerable area of swamp. Sites are located on higher ground just south of the narrow strip of land separating the pond from the lake (Site 17*a*), and also on higher ground to the west, between the pond and Dead Creek (Site 16).

Vermont side (Franklin, Monkton and Bristol ponds and Lakes Dunmore and Bomoseen)

Franklin Pond, or Lake Carmi, about ten miles from the main lake near the Missisquoi River, was a favorite resort for the Abenakis. Its main outlet is to the north, but swamps at its

[86] Weeks, J. M., *History of Salisbury*, pp. 18–19.

southern end drain into the Missisquoi, so that it was conveniently reached from either direction. Abundant traces of occupation have been found around this lake.[87]

Monkton Pond and Bristol Pond, both draining into Lewis Creek, were much frequented by the Indians. The list of relics from Monkton, most of them from Monkton Pond, speaks for occupation and activites that were not entirely transitory.[88] A village site (93) has been located near the outlet of the pond, not far from swamp lands to the northeast. A burial ground (Site 94) was disclosed previous to 1830, and some four or five skeletons were uncovered.[89]

Bristol Pond was an ideal location for Indian activities, situated as it was in a region intersected by the headwaters or tributaries of three streams (Lewis Creek, Little Otter Creek and the New Haven River), at the foot of the long ridge of Hogback Mountain, and surrounded on three sides by swamp land. There are three or four islands in the pond. A partial list of relics found there is suggestive, as in other cases, of the character of the occupation.[90] Village site 90 is located nor far from the outlet of the pond.

Lake Dunmore lies well back under the shadow of the Green Mountains and with it are associated other smaller lakes (including Mud Pond, Fern Lake and Silver Lake east of the front range). Its Indian name, Moosalamoo, was significant, meaning "the salmon-trout lake." [91] Lake trout abounded in its waters in the early days. It is said that many of them weighed fifteen or twenty pounds.[92] Not far from the outlet stream (Leicester River) of Lake Dunmore and a little to the east of Salisbury village, on

[87] Truax, L. B., *op. cit.*, p. 29.

[88] Arrow points, 10 knives, 5 pestles, 2 gouges, pieces of pottery, 2 drills, 11 celts, rubbing-stone, grooved axe, 2 hammerstones, 2 banner stones.

[89] Swift, S., *op. cit.*, p. 42.

[90] Mortar, rude axe, 4 knives, 2 pestles, 3 drills, 2 celts, rubbing-stone, 6 hammerstones, plummet or net sinker (in Burlington collection); also pieces of pottery which may be both Algonkian and Iroquoian (now in the state cabinet at Montpelier).

[91] The name is now applied to the prominent peak rising up to 2,659 feet near the north end of the lake.

[92] Swift, S., *op. cit.*, p. 17. This perhaps is a real "fish story." It is probably some species larger than lake trout, perhaps muskalonge.

sandy morainic soil, were found many arrow-heads, pestles, earthen-ware vessels and other indications of a former savage home. For many years the spot was known by the name of "Indian Garden." [93]

Lake Bomoseen,[94] in Castleton, was often frequented by the Indians. This lake extends north and south for about seven miles among the Taconic hills. With it are associated Glen Lake and numerous ponds to the north. During much of the season the northern end of the lake is a big swamp. The district is most easily approached from the Castleton Valley at its southern end. Little is known about the Indian history of this district, but traces of occupation have been found on the shores of the lake, on Neshobe Island and near the neighboring hills. The plain southeast of the island, known as the Indian Fields, was a great resort for the natives. Stone celts, gouges, knives, hammerstones, and dressing-stones occur there. Clusters of fire-burnt stones were seen along the shore and on the meadows. Stone agricultural implements, as well as mortars and pestles, indicate rather extended occupation. Net sinkers show that fishing was carried on.[95] Neshobe Island, originally covered by hemlock and oak (which has given way to birch and oak), was named at a celebration of the Rutland Historical Society (1881) in honor of an Indian spy or scout of that name who espoused the cause of the Green Mountain Boys. He is said to have resided on the east shore of Lake Champlain.[96] Southeast Cape (or Cedar Point), a projecting point on the west shore of Bomoseen, has been called Taghcannac or Tagacannac Point. This is a corruption of Taconic.[97]

[93] Weeks, J. M., *op. cit.*, pp. 117–118.

[94] This lake appears to have been named after a Penobscot (Abenaki) Indian chief who resided near Norridgewock, Maine.

[95] Currier, J. M., *An Account of the Celebration . . . at Mason's Point*, p. 19.

[96] The name "Neshobe" was, it seems, also applied to the vicinity of Brandon, Vermont, and still survives in the name of the river that is tributary to the Otter at that place.

[97] The name "Taconic" is said to signify a "field in the woods," or "forest plantation" (see Adams, C. B., *Second Annual Report on Geology of Vermont*, 1846).

New York side

On the New York side the inland lakes that have most abundant evidence are Schroon Lake, draining by the Schroon River to the Hudson; Lake Placid, at the headwaters of the Ausable; and Upper Chateaugay Lake. A village site (50) where pottery has been found is on the eastern side of Schroon Lake and another (49) is on the flats near the village of Schroon Lake. The islands also were utilized by the Indians. Gaywanot, signifying "island," was the name given to Isola Bella, on which, apparently, there had been inhabitants. Likewise, traces of occupation are reported from the north end of Lake Placid (Site 40), from Moose and Buck Islands (Site 41), and from Mirror Lake to the south (Site 42). The sites, near the outlet of Upper Chateaugay Lake, have already been tabulated (Chapter I). In addition to the archaeological evidence, numerous Indian names still exist for various natural features — lakes, mountains, rivers — that played a part in the aboriginal life.[98] In general, the evidence shows that the occupation of the district was predominantly Iroquoian. This was distinctly encouraged by the physical layout of the Adirondacks and the greater accessibility of these lakes from the south and west.

Such are the bits of evidence that point to the penetration of the innermost parts of the "wilderness" by the Indians. We may assume that many lakes and ponds in addition to these mentioned, such, for example, as Shelburne Pond, were a lure to the Indian fisherman and hunter.

D. Summary of Distribution of Village Sites and Camp Sites

The following table indicates some of the environmental adjustments in the occupation of the region that have already been suggested:

[98] Three names are reported, for instance, by Sabattis as being applied to the Saranac lakes: Paskongammuck (to the lakes as a whole), Cangammuck (Lower Saranac Lake), Sinhalonennepus (Lower Saranac Lake). These names in part show Algonkian derivation.

	Village sites	Camp sites	Traces
Total number of sites	57	50	24
On or near Lake Champlain itself	31	20	9
On tributary streams (including some other inland locations)	16	30	16
On inland ponds	8	2	5
Portage sites	7	18	..
Island sites	3	11	4
River mouth sites	34	15	..

The chief concentration of occupation was along the main lake, and the distribution of sites indicates both transient use of the lake and its shore and recurring use for hunting and fishing. The predominant number of camp sites along tributary streams (including a very few at other inland locations) indicates transient use of these routes. In this connection the number of camp sites at or near portages is suggestive. Most of the village sites near the inland ponds reflect the extensive use of those areas for hunting and fishing. With these, several of the island sites are to be classed. It is significant that more than 40 per cent of all the sites are located at or near the mouths of streams.

E. Indian Habitations

The family wigwam; supplementary use of earth

There is relatively little evidence as to the character of the habitations that occupied the various sites. In view of the perishable nature of such structures as well as the intermittent character of the Indian occupation, this is not surprising. Numerous early travelers and settlers mention "wigwams," yet there is little detailed description from which we can get a fair picture of Indian structures and dwellings. The term appears to have been applied quite indiscriminately to various types of habitations. The Indians used the material that was at hand, and their structures represented good environmental adjustments. In fact, dependence upon natural materials probably many times dictated just where habitations should be placed. It appears, too, that in some respects the type of structure varied with the group; hence we find again the mingling of Algonkian and Iroquois cultures. For many

years the coming of the white man hardly altered the type of Indian habitation, especially that of the smaller ones.

The individual camp, or family wigwam, was the important habitation unit, whether a lodge, a home in a village or a hunting camp. The lodge was relatively permanent, not close to other dwellings, yet usually near enough to others to be associated with them. Among the Abenakis especially the blood family or clan was the important social unit. Among the Iroquois we find larger political groupings, or "nations," having great strength and there was developed a large council house or "long house." In the lower valley of the Missisquoi lodge sites appear to have been very common. Throughout the whole lowland the presence of many hearths, some of them paved with stone, shows the importance of the family group. The fireplace was built within the crude wigwam and its chief purpose was for cooking, not heating. The framework of the dwelling itself was always of wood, usually four or more poles driven into the ground. Others were laid on to support the roof, or else the slender tops would be drawn together and fastened. The dwellings either had no walls at all or else consisted of matted boughs or branches with leaves, fixed to the poles. The roof, of course, had to be more substantial, frequently being made of a thatch of reeds and rushes. Bark, too, was used either alone or better still, combined with a thatch which made it practically impervious to water.[99]

The structures varied in size and material. The little camps constructed while on hunting trips were the smallest of all, oftentimes mere lean-tos. "The Indian hunting houses are generally but the work of half an hour at the most, and sometimes they [the Indians] range through the woods for months together, without any house at all, or any covering but a skin or blanket." [100] Other accounts show also that for the more temporary type of shelter skins of animals were frequently stretched on poles or saplings that were cut on or near the spot. The first settler at Rutland describes a less temporary camp near a beaver meadow as follows,

[99] Gookin, *Historical Collections of the Indians in New England*, 1 : 123; also Kalm, P., *Travels into North America*, p. 591.

[100] Rogers, R., *Account of North America*, p. 247.

"Nearby, on a more elevated site, is a wigwam, with perhaps 9 or 10 Caughnawaga Indians around a cozy fire." When he applied for shelter, the Indians abandoned their hut to the palefaces and quickly built another for themselves.[101] Thus construction was easy. One writer speaks of the structures as being from twenty to forty, or even a hundred feet, in length, and up to thirty feet broad. The best developed habitation was the Iroquois "long house" made of bark, long and narrow, with fires placed at intervals in the long aisle and with couches or floors on either side. Many of these huts were of great length and held many families.[102] While the Iroquois habitations may not have reached so high a development in the Champlain Lowland as in their home villages, yet their occupation in this region was regular enough for this type to make its appearance. Radisson frequently speaks of "cottages" and "cabbans" along the New York shore, dwellings which may well have been of this type.

In building a wigwam a slight excavation was made, or, more frequently, earth was thrown up around the base of the structure in a low ridge. The object was to help keep out the water, to keep in the heat, and to effect a saving in the amount of thatching needed. Early settlers are known to have found the remains of a number of these ridges. A farmer in Cornwall, for example, found "what was regarded as the foundation of an Indian wigwam or hut." It was a ridge of earth, about six inches high, in the form of a square, the sides of which were eight to twelve feet long. The square was complete except at the east and where there was a vacant space, apparently designed for a doorway. The earth was thrown up to form the ridge on the outside.[103] The mounds and embankments of an ancient Indian wigwam were discovered in 1809 in Richmond (Site 100). Its antiquity was shown by the fact that a large birch over three feet through stood on the mound.[104] "Mounds" [105]

[101] Williams, C. K., *Hemenway Gazetteer*, 3, 1016, *s. v.* "Rutland."
[102] Beauchamp, W. M., *History of the New York Iroquois*, pp. 139–140.
[103] Swift, S., *op. cit.*, p. 36.
[104] Davis, S. H., *Hemenway Gazetteer*, 1 : 847–848, *s. v.* "Richmond."
[105] Thompson, D. P., *History of Montpelier*, p. 18. In some respects this mound seems to have resembled those of the mound-building Indians. Six feet or more of it have been scraped away, but only a few implements have been reported. It may be that this was a natural, rather than artificial, elevation.

also have been found on the old Collins farm, about two miles below Montpelier, as well as at other places near by. Here the mound was rectangular, and some forty or fifty feet across; it had an elevation of about eleven feet, with sides sloping at an angle of about sixty degrees. It was situated at the opening of a narrow glen-like passage running back among the hills, flanked by two opposing bluffs. Relics near by show that a light, loamy, level stretch of land bordering the Winooski, nearly half a mile wide and one and one-half miles long, was extensively occupied.[106]

ROCK SHELTERS AND CAVES

The Indians at times utilized rock shelters and caves. Though not a cave-dwelling race, they occasionally had such places for "caches" or for protection. The rugged mountains, as well as the soluble limestone areas of the lowland, afforded many natural shelters that may have been used. The Cobble near the Bristol-Middlebury town line, Deer Leap Caves at Sherburne Pass, and a cave in Hinesburg are examples of such places. The finding of a large Indian pot in a cave near Bolton Falls on the Winooski is good proof of the use of such a shelter along a main route. Early comers in Salisbury, Vermont, are said to have found the remains of an Indian dwelling attached to "Warners Cave" (Ethan Allen Cave, east of Lake Dunmore). It seems not unlikely that the Indians used this cave for a storehouse and possibly as a place of safety, but there is little indication to show that it served any further purpose.[107]

LACK OF LARGE INDIAN TOWNS

For obvious reasons, large villages or Indian towns rarely existed in the region. In any event most of them were short-lived. The settlement at Missisquoi, consisting at one time of some fifty huts and lasting for about seventy-five years (1687–1760), was the largest. Radisson speaks of a camp of "14 Cabbans."[108] The sites at Isle la Motte (8), the head of Cumberland Bay (21), and

[106] Brigham, G. N., *Hemenway Gazetteer*, 4 : 2, *s. v.* "Washington County."
[107] Weeks, J. M., *History of Salisbury*, p. 149.
[108] Radisson, P. E., *Voyages*, p. 37.

Colchester Point (104) were evidently large settlements. Much larger towns than any of these were situated on the St. Lawrence and in the Mohawk country. A description of the village at the site of Montreal will serve to give a picture of the character and layout that were typical of one of the larger settlements. This was as Cartier saw it in 1534:

> Hochelaga (an Iroquois settlement at this time) stood in the midst of great fields of Indian corn; it was of a circular form, containing about fifty large huts, all built in the shape of tunnels, formed of wood, and covered with birch bark; the dwellings were divided into several rooms, surrounding an open court in the centre, where the fires were burned. Three rows of palisades encircled the town, with only one entrance; above the gate, and over the whole length of the outer ring of defense, there was a gallery, approached by flights of steps, and plentifully provided with stones and other missiles to resist attack. This was a place of considerable importance, even in those remote days, as the capital of a great extent of country, and as having 8 or 10 villages subject to its sway. The inhabitants spoke the language of the Great Huron nation and were more advanced in civilization than any of their neighbors; unlike other tribes, they cultivated the ground and remained stationary.[109]

Seventy years later it had sunk into a decayed and unimportant place.

The motive of protection was always strong in the construction of a village, as well as in the choice of a site for one. The building of palisades and earthworks was common. When the whites came, the Iroquois had almost abandoned the use of earthworks in favor of the more highly developed palisade. Champlain describes the precautions taken when they stopped at the Isle Ste. Thérèse:

> Immediately they all began, some to cut wood, others to strip off the bark of trees to cover their cabins, to provide shelter for themselves; others began to fell big trees for a barricade on the bank of the river about their cabins. They know so well how to do this that in less than two hours five hundred of their enemy would have had a good deal of trouble to attack them without losing a great many of their number. They do not barricade the side toward the river, where their canoes are drawn up, so as to be able to embark, if occasion requires.[110]

The St. Francis villages near the mouth of that river were always associated with the historical development of the Cham-

[109] Warburton, G. D., *Conquest of Canada*, p. 1.
[110] Champlain, G. D., *Conquest of Canada*, p. 1.

plain country. In 1759 Robert Rogers found several hundred Indians living there in houses that had "cellars and lofts," which facts show that the larger the village, and the nearer it was to white influence, the sooner were there changes in architectural adjustments.[111] It was more than a century after the beginning of the historical period before the Iroquois adopted the log house to any extent,[112] and in the habitations of the family or small group we find aboriginal adjustments persisting longest.

Summary

Thus a detailed consideration of the character and distribution of the occupied sites emphasizes: (1) the transient and fluctuating occupation of this region as a whole by the Indians; (2) the successive occupation of the region by different aboriginal groups; (3) predominance of Iroquoian and Algonkian occupation in those districts most accessible to each group; (4) the frontier character of the central part of the region; (5) the relatively regular settlement along the northern Vermont shore; (6) the relatively irregular settlement along the main outlet channel of the lake; (7) the prime importance of focal areas or junction points in Indian routes as areas of settlement; and (8) penetration by Indians to the innermost recesses of the whole wilderness area for fish and game. An examination of the evidence concerning the habitations of the Indians in this region emphasizes in large measure the foregoing conclusions.

The highway and warpath character of the Champlain Lowland was the primary factor affecting the nature of its occupation by the Indians. A study of the occupied sites and of the historical evidence, meager though the latter is, brings out the temporary and intermittent qualities of this occupation, as well as the natural advantages of this wilderness as a great hunting and fishing ground. If we can clearly visualize, in their original regional setting, these sites and the habitations which occupied them, it is then easier to picture the various activities of these seminomadic peoples.

[111] Rogers, R., *Journals*, p. 147.
[112] Beauchamp, W. M., *History of the New York Iroquois*, pp. 139–140.

The author is anxious to express his gratitude to all those who in one way or another have aided him in this study. In particular, he owes much to Ellen Churchill Semple for a first inspiration in historical geography while he was at Clark University, and to Harlan H. Barrows for later valuable contacts in this field at the University of Chicago and for encouragement and guidance in this study.

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TRESPASSING UPON THE DIVINE DOMAIN: POPULAR RELIGIOUS SUPERSTITIONS

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THE sides of the road that Science has trodden from its lowly, groping beginnings to its present heights are littered with discarded religious beliefs and superstitions. In a limited sense the history of the progress of mankind is the history of the discarding of superstitions and of the transfer of phenomena from the realm of the supernatural to the natural. In this movement no nation has done more than the Greeks and none is to be more honored, for they were pioneers in Europe in the serious effort to establish and prove relations of cause and effect. The process was so new to them that not all their most intellectual minds could adopt the new attitude unreservedly. Some investigators who were eager to embrace it for matters under their own observation retained generally prevalent views about things outside their own provinces. The historian Polybius,[1] who was open-minded and discerning, is a good example. He thinks that natural phenomena for which a logical reason can be found should not be ascribed to the action of the gods, but he took the course of least resistance in leaving a field of activity for the gods in things which it was difficult or impossible for a human being to understand. Plagues, unusually heavy and long-continued rains and snows, and severe frost and drought might rightly, perhaps, be attributed to the agency of the gods.

It is difficult for one living in an age of research to understand the mental outlook of a period when the scientific approach to knowledge was in its infancy. Today we take it for granted that all phenomena have a rational explanation, but as late as classical antiquity a work was written in an endeavor to free man from

[1] 36.17.1–4 (6: 382–383, in the Loeb Classical Library edition).

superstitious fear of such common things as thunder and lightning and earthquakes.[2]

The awe of natural phenomena which the first investigators had to overcome is vividly pictured by Seneca:[3] "It was an undertaking requiring great courage (for man) to expose the lairs of Nature, and, not content to behold her from the outside, to view her from within and to delve into the secrets of the gods. He contributed a great deal to discovery who hoped that discoveries could be made."

Pliny the Elder[4] is lost in admiration for minds that are capable of probing the heavens and nature in general and of finding evidence to refute both gods and men. He could pronounce a eulogy and a blessing upon the inquiring spirits who discovered the natural causes of eclipses, but he did not have the penetration to see that there might be a natural explanation for other things that aroused his dread, comets, for instance. Lydus[5] gives a scientific explanation of eclipses, but as soon as he catches his breath again he goes on to record superstitions about them.

Many articles and books have been written on the conflict of religion and science. Perhaps Andrew D. White is more accurate in using a stronger word than "conflict" in the title of his two-volume work, *A History of the Warfare of Science with Theology in Christendom.*[6] Each generation seems to find new issues with which to renew the struggle, but most of the ideas here recorded are of such a nature that no one with intelligence enough to argue would think of upholding them.

I am interested at present in the opposition of untrained minds to all forms of initiative and progress which they do not understand and which they think controvert the divine will and transgress literally or figuratively upon the divine domain. We assume that it is man's privilege and duty to pry into the ways of Nature, but there always have been and still are people who think there are

[2] Lucretius, *De Rerum Natura.* [3] *Nat. Quaest.* 6.5.2.

[4] *Nat. Hist.* 2.54: "Viri ingentes supraque mortalia, tantorum numinum lege deprehensa et misera hominum mente iam soluta, in defectibus scelera aut mortem aliquam siderum pavente. . . . Macte ingenio este, caeli interpretes rerumque naturae capaces, argumenti repertores, quo deos hominesque vicistis!" [5] *De Ostentis* 9. [6] D. Appleton and Co., New York, 1896.

certain bounds beyond which inquiry and investigation should not go. It is with the beliefs of such people that I am concerned. Some of my modern examples are contemporary in spirit with my two oldest ones, which are taken from Herodotus.[7]

VIOLATIONS OF THE SANCTITY OF SEA, LAND AND AIR

One of the earliest transgressions of man upon the divine domain was putting out to sea. Man is a terrestrial creature, as Columella[8] says, and it was axiomatic in Graeco-Roman antiquity that the gods created man to live upon the land. It was for his welfare that the waters were parted from the land. During the happy Golden Age man was content to remain upon the land without engaging in seafaring.[9] The waters were sacred, being in the realm of the gods. The first barks that ventured to intrude upon it were challenges to the almighty powers and violated the laws of both nature and the gods. Man was forbidden to learn the things on the bounds of the world. "In vain," exclaims Horace,[10] "did a provident god sunder the land from the ocean if, in spite of all, impious barks bound over seas not intended to be coursed." Another representative passage on the impiety of transgressing upon the sea is one by Albinovanus Pedo:[11]

> "Di revocant rerumque vetant cognoscere finem
> Mortales oculos; aliena quid aequora remis
> Et sacras violamus aquas divumque quietas
> Turbamus sedes?"

Such ideas are commonplaces in Greek and Latin literature,[12] but they express feelings which at one time had been real rather than affected.

[7] See pp. 165 and 181. [8] 1, *Praefat.* 8: "terrestre animal homo."

[9] Hesiod, *Works and Days* 236; Aratus, *Phaen.* 110–111.

[10] *Carm.* 1.3.21–24: cf. Ovid, *Met.* 1.22: "Nam caelo terras et terris abscidit undas"; Sen., *Medea* 335–336: "bene dissaepti foedera mundi traxit in unum Thessala pinus."

[11] As quoted by Seneca, *Suas.* 1.15. See also Val. Flacc., *Arg.* 1.627–628:

> "Hoc erat inlicitas temerare rudentibus undas
> Quod nostri timuere patres."

[12] Copious references are to be found in K. F. Smith, *The Elegies of Albius Tibullus* (The American Book Co., New York, 1913), p. 246.

Pliny the Elder [13] speaks with awe of the temerity of man in adding entire trees (i.e. masts) and sails to ships and in catching winds and squalls with sails. Man was no longer content to die upon the land and inventors were seeking new ways of meeting death.

In modern times, after man had become used to the idea of wind-driven vessels, the introduction of steam has sometimes been regarded as sacrilege. In Victor Hugo's *The Toilers of the Sea*,[14] a story of the Channel Islands, much is made of the superstitious attitude of the ignorant toward the introduction of the steamboat, the "devil boat," as it was called. A local preacher delivered a discourse on the subject "Whether man has the right to make fire and water work together when God had divided them." [15]

"In the year 1807, when the first steamboat of Fulton . . . made her first voyage from New York to Albany, it happened that she set sail on the 17th of August. The Methodists took up this important fact, and in numberless chapels preachers were heard calling down a malediction on the machine, and declaring that this number seventeen was no other than the total of the ten horns and seven heads of the beast in the Apocalypse. In America, they invoked against the steamboats the beast from the book of Revelation; in Europe, the reptile of the book of Genesis. That was the simple difference.

"The savants had rejected steamboats as impossible; the priests had anathematized them as impious. Science had condemned, and religion consigned them to perdition. Fulton was a new incarnation of Lucifer. The simple people on the coasts and in the villages were confirmed in their prejudice by the uneasiness which they felt at the outlandish sight. As regards steamboats, the religious standpoint may be summed up as follows: Water and fire were divorced at the creation. This divorce was enjoined by God himself. Man has no right to join what his Maker has put asunder; to reunite what he has disunited. The peasants' view was simply, 'I don't like the look of this thing.'" [16]

[13] 19.5–6.
[14] 1: 69–70 (edition published by Little, Brown, and Co., Boston, 1894).
[15] See Genesis 1.4. [16] Victor Hugo, *op. cit.*, pp. 70–71: cf. p. 78.

The fear which some of the ancients felt about violating the sanctity of the sea may be paralleled by the feelings with which the untutored look upon man's adventures into the air. Maum Hannah, a character in Julia Peterkin's *Black April*, cries out as she hears an airplane "so high that its buzz was hardly more than the hum of the wind":

"'Pray, chillen, pray! Talk wid Jedus! I too sorry to see you dis mawnin'!' She shook her old head, and shouted again: 'Gawd don' like mens to go up in de elements! Dis is His day, too! Pray, chillen, pray! Do, Jedus, hab mussy on dem. I hope dey ain' none o' we white folks.'" [17]

An act not less impious than sailing the sea or navigating the air was the endeavor to change the configuration of the earth's surface. While Harpagus, one of the generals of Cyrus the Great, was laying waste Ionia, the Cnidians, who lived on a peninsula that extended out from Caria into the Aegean Sea, decided to make an island of their country by digging across the neck of land behind them. When a large force of workmen was engaged in the operation they began to suffer wounds, especially about the eyes, from the splintering of rocks. A mission which was sent to the oracle at Delphi to ask the reason for this strange occurrence brought back a terrible reply: "Fortify not the isthmus, nor dig, for Zeus would have made an island had he willed." On learning this, the Cnidians ceased work at once and yielded to Harpagus without a struggle.[18]

Habits of thought persist. This pagan story has a Christian analogue in religious opposition to cutting a canal across the Isthmus of Panama: [19] "The Jesuit father, Joseph de Acosta, who crossed the Isthmus in 1570, on his way to Peru, declares that he held as vain all pretensions to open the land, and that 'no human power will suffice to demolish the most strong and impenetrable mountains and solid rocks, which God has placed between the two

[17] Page 117 (Grosset & Dunlap. Copyright by the Bobbs-Merrill Co., Indianapolis, 1927).

[18] Herod. 1.174. The oracle is included in the *Greek Anthology*, 14.81. In their commentary on this passage in Herodotus How and Wells say: "The isthmus still shows traces of the unfinished cutting."

[19] C. L. G. Anderson, *Old Panama and Castilla del Oro* (Boston, The Page Co., 1914), p. 312.

seas, and which sustain the fury of both oceans. And when it will be to men possible, it would, in my opinion, be very proper to fear the chastisement of Heaven for wishing to correct the works which the Creator, with greatest deliberation and foresight, ordained in the fabrication of this Universe.'"

Fear of divine displeasure played its part in influencing Spain to abandon the project of a canal. With rare humor a modern historian [20] comments as follows upon the Jesuit father's conclusion: "Who dares to affirm that Acosta was wrong in his declaration? The divine injunction, not to put asunder what God hath joined together, may apply to continents as well as to human wedlock."

Penetrating into the interior of the earth is another form of sacrilege. Aeneas, descending to the Lower World, prays that it may be the divine will to disclose the secrets hidden by the earth and darkness.[21] In modern times the more violent methods of getting beneath the surface have likewise been regarded as impious. I am willing to take almost at its face value the following incident narrated by Bret Harte in "A Millionaire of Rough and Ready": [22]

"In this emergency Mulready thought of sinking an artesian well on the sunny slope beside his house; not, however, without serious consultation and much objection from his Spanish patron. With great austerity Don Ramon pointed out that trifling with the entrails of the earth was not only an indignity to Nature almost equal to shaft-sinking and tunneling, but was a disturbance of vested interests. 'I and my fathers — San Diego rest them!' said Don Ramon crossing himself — 'were content with wells and cisterns, filled by Heaven at its appointed seasons; the cattle, dumb brutes though they were, knew where to find water when they wanted it. But thou sayest truly,' he added with a sigh, 'that was before streams and runs were choked with hellish engines, and poisoned with their spume. Go on, friend Mulready, dig and bore if thou wilt, but in a seemly fashion, and not with impious earthquakes of devilish gunpowder.'"

[20] Anderson, *loc. cit.* [21] Verg., *Aen.* 6.266–267.

[22] *Marujah and Other Tales* (Volume V of the Riverside Edition, 1885), pp. 259–260.

INVENTIONS AND DISCOVERIES

There are several passages in classical literature in which discoveries and inventions in general are regarded with awe,[23] but, strange to say, more religious opposition has been made to them in later times than in antiquity.[24] We shall see that this is due in no small measure to a few verses in Genesis.

Many twists of imagination and understanding have been manifested in this religious hostility to the use of mechanical devices. It would be hard to find an objection more ingenious than that recorded against winnowing machines by Sir Walter Scott in *Old Mortality*.[25] A vassal, who, with her son, is threatened with dismissal from a barony, thus "airs a grievance":

". . . And since your leddyship is pleased to speak o' parting wi' us, I am free to tell you a piece o' my mind in another article. Your leddyship and the steward hae been pleased to propose that my son Cuddie suld work in the barn wi' a new-fangled machine for dighting the corn frae the chaff, thus impiously thwarting the

[23] E.g. Soph., *Antig.* 332–364; Pliny 19.5. Like the first ship, the first sword brought many evils. A representative passage is Tibullus 1.10.1–4:

"Quis fuit horrendos primus qui protulit enses?
Quam ferus et vere ferreus ille fuit!
Tum caedes hominum generi, tum proelia nata,
Tum brevior dirae mortis aperta via est."

[24] The ancients ascribed many inventions to the beneficent gods and exalted almost to divinity men who conferred boons upon their fellow-men. An excellent reference is Aesch., *Prom.* 436–506, where an imposing list is attributed to Prometheus, though some of them are credited to other inventors by later writers.

[25] Chap. VI. Another story, equally interesting, is to be found in W. Gregor, *Notes on the Folk-Lore of the North-East of Scotland*, p. 183 (Publications of the Folk-Lore Society, Vol. 7): "When fans were introduced, there was great prejudice against the use of them. The wind was looked upon as the means provided by the Father of all for separating the chaff from the grain, and to cast it away and use artificial wind was regarded as a slur on His wisdom and a despising of His gifts. An old-fashioned man in the parish of Pitsligo, on seeing a neighbour proceed to winnow his grain with a fan, cried out: — 'Eh! Sauny Milne, Sauny Milne, will ye tak' the poor oot o' the Almichty's han'?'"

A somewhat similar superstition is to be found in Wild, *Highlands, Orcadia and Skye*, p. 196, but I have not been able to consult this reference.

will of Divine Providence, by raising wind for your leddyship's ain particular use by human art, instead of soliciting it by prayer, or waiting patiently for whatever dispensation of wind Providence was pleased to send upon the sheeling hill."

This story was used by Sir James Y. Simpson, a Scotch physician who was the first to use chloroform in medical practice and who in 1847 wrote a pamphlet called "Answer to the Religious Objections Advanced against the Employment of Anaesthetic Agents in Midwifery and Surgery,"[26] but Dr. Simpson himself has some interesting parallel material that is pertinent to this paper:

"Formerly, among my countrymen, most agricultural operations were performed, as commanded in the primeval curse, by personal exertion, and the 'sweat of the face.' Corn, in this way, was winnowed from the chaff by tossing it repeatedly up into the air, upon broad shovels, in order that any accidental currents which were present might carry off the lighter part. At last, however, about a century ago, 'fanners,' or machinery made for the production of *artificial* currents to effect the same purpose, were invented and introduced into different parts of the country. Some of the more rigid sects of Dissenters loudly declaimed against the employment of any such machinery. 'Winds (they argued) were raised by God alone, and it was irreligious in man to attempt to raise wind for the aforesaid purpose for himself, and by efforts of his own.' Mr. Gilfillan, the well-known Scottish poet, has furnished me with evidence of one clergyman debarring from the communion of the Lord's Supper those members of the flock who thus irreverently used the 'Devil's wind' (as it was termed). And such sentences, I believe, were not uncommon almost within the memory of some aged members of the present generation."

The same attitude of mind has been carried into South Africa, presumably by missionaries: "Honest countryfolk of European descent are earnestly counselled by their spiritual advisers to submit patiently to the plague of locusts on the ground that it

[26] This pamphlet is reprinted in *Anaesthesia, Hospitalism, Hermaphroditism, and a Proposal to Stamp out Small-pox and Other Contagious Diseases*, by Sir James Y. Simpson (edited by Sir W. G. Simpson [D. Appleton and Co., New York, 1872]), pp. 42–55. The quotation is on page 52. The entire document is worth reading. Its author was very human, humorous and humane.

comes as a punishment from Providence. These worthy men stolidly witness their cornfields and their grass lands eaten bare before their eyes in a few hours, whilst their more enlightened neighbours, brought up in another faith, resort with success to all sorts of artifices to ward off the destructive little invaders." [27]

Inventions other than airplanes and winnowing machines have stirred up religious feeling:

"In Lancaster, Ohio, in 1828, a debating society of young men applied for the use of the schoolhouse. The school board answered:

" 'You are welcome to the use of the schoolhouse in which to debate all proper questions; but such things as railroads and telegraphs are impossible and rank infidelity. There is nothing in the Word of God about them. If God had designed that his intelligent creatures should travel at the frightful speed of fifteen miles an hour by steam, He would have clearly foretold it through His holy prophets. It is a device of Satan to lead immortal souls to hell.'" [28]

MEDICINE AND SURGERY

The development of medicine in Graeco-Roman antiquity was greatly hindered by religious ideas, although the priests in temples did learn much as a result of their frequent contact with patients. Diseases were supposed to be inflicted by the immortal gods.[29] A striking evidence of this belief is the name "sacred disease" for epilepsy. I doubt not that Milton included diseases among the things to be charged to

> ". . . man's first disobedience, and the fruit
> Of that forbidden tree whose mortal taste
> Brought death into the world, and all our woe."

Though misguided notions hampered the study of medicine among the Greeks and Romans,[30] they did not lead the patients to

[27] H. L. Gordon, *Sir James Young Simpson and Chloroform* (T. Fisher Unwin, London, 1897), pp. 124–125.

[28] Bruce Barton, *New York Herald Tribune Magazine*, July 15, 1928, p. 8.

[29] Celsus mentions the belief in the Preface to his work. An interesting reference is C. R. Simboli, *Disease-Spirits and Divine Cures among the Greeks and Romans* (a Columbia University dissertation, New York, 1921).

[30] See, for example, Hippocrates, *De Morbo Sacro* 1.

the point of doing nothing for their afflictions, a situation that has not been uncommon in modern times. In our own country smallpox has been considered a manifestation from God and those who took measures against it sometimes aroused a storm of hostility, as happened in the case of Dr. Zabdiel Boylston, a Boston physician who inoculated his own son about the year 1721: [31]

"The violence of the opposing party knew no bounds; they insisted that inoculation was 'poisoning,' and they urged the authorities to try Dr. Boylston for murder. Having thus settled his case for this world, they proceeded to settle it for the next, insisting that 'for a man to infect a family in the morning with smallpox and to pray to God in the evening against the disease is blasphemy,' that the smallpox is 'a judgment of God on the sins of the people,' and that 'to avert it is but to provoke him more,' that inoculation is 'an encroachment on the prerogatives of Jehovah, whose right it is to wound and smite.' Among the mass of scriptural texts most remote from any possible bearing on the subject one was employed which was equally cogent against any use of healing in any disease — the words of Hosea: [32] 'He hath torn, and he will heal us; he hath smitten, and he will bind us up.'"

In Scotland theological objectors to vaccination were typified by a Dr. Rowley, who argued that "Small-pox is a visitation from God, and originates in man, but the cow-pox is produced by presumptuous, impious man. The former, heaven ordained; the latter is perhaps a daring and profane violation of our holy religion." He was much concerned "whether vaccination be agreeable to the will and ordinances of God, as a question worthy of the consideration of the contemplative and learned ministers of the gospel of Jesus Christ; and whether it be impious and profane, thus to wrest out of the hands of the Almighty the divine dispensation of Providence!" [33]

Opposition among the laity took a little different turn. One lady "complained that since her daughter was inoculated, she coughs like a cow, and has grown hairy all over her body." Bellowing like bulls was another aftermath of this innovation.[34]

[31] A. D. White, *op. cit.*, 2.56. See also 57–61. [32] 6.1.
[33] Page 51 of work cited in note 26. [34] Page 69 of the same work.

According to a newspaper clipping many parents of London school children are still unwilling to have them profit by medical attention. One parent wrote as follows to a schoolmaster who reported the result of an examination: "I desire my daughter's teeth to remain as they are. The same power that placed them there will make due change when necessary." Another replied: "Squint is God-given. It is wrong to tamper with it." Still another said: "Father has squinted all his life and sees quite well without glasses."

Mr. Voliva, whose claim to fame rests on his assumption and assertion that the earth is flat, is quoted by a newspaper as saying: "You shouldn't use a pain killer when you get your teeth pulled."

On the prejudice against the use of anesthetics Dr. Grenfell is interesting: [35]

"I can never forget my first operation in Labrador. The patient was a large woman who had a tumor on her leg. I told her it could be removed by a simple operation, and that she would feel no pain under the ether. But she shook her head in solemn protest against the anesthetic. 'If the blessed Lord sends pain, us has got to bear it,' she said. When the time came, she appeared accompanied by five husky fishermen. 'I bring these men to sit on me, Doctor, and hold me down, so's you won't have to give no ether.' We proceeded accordingly, the operation was successful, and the patient recovered.

"There were many scruples like this in our early years in Labrador. The people are deeply religious, and anything suggesting an evasion of divine providence is regarded as sinful. Eventually we got them to accept the idea that chloroform is a blessing from God, and now there is no longer any conscientious objection to its use."

The Lord's sentence upon Eve, "I will greatly multiply thy sorrow and thy conception; in sorrow thou shalt bring forth children," [36] has given rise to a strong prejudice against any effort to mitigate the pangs of childbirth. According to Victor Hugo,[37]

[35] George W. Gray, "The Labrador Doctor," *The American Magazine*, April, 105 (1928) : 47.

[36] Genesis 3.16.

[37] *Toilers of the Sea* (as cited in note 14), 1 : 69.

the Channel Islanders censured a queen of England (Victoria) [38] for using chloroform during *accouchements*.

In Scotland the religious arguments against the use of anesthesia were answered by Dr. James Y. Simpson, who met his adversaries on their own ground by appealing to the Bible in defence of the new aid to medicine and surgery.[39] To convince naïve people he became naïve himself. He called attention to other punishments besides that inflicted upon woman. To Adam the Lord said: "In the sweat of thy face shalt thou eat bread." [40] Upon the ground a curse was invoked: "Thorns also and thistles shall it bring forth to thee." [41] Dr. Simpson showed that these pronouncements of the Lord were not literally heeded. Man saved the sweat of his face by using horses and oxen and even water-power and steam-traction. Farmers disregarded the curse upon the ground by pulling up thorns and thistles. But the most convincing (and most naïve) argument was that the Lord himself employed anesthetics in the first recorded operation: "And the Lord caused a deep sleep to fall upon Adam, and he slept; and he took one of his ribs, and closed up the flesh instead thereof." [42] (See Fig. 4.)

ACADEMIC KNOWLEDGE

There has always been opposition to academic knowledge in certain fields on the ground that it tends to weaken religion. In antiquity Lucretius feared that Gaius Memmius, to whom he dedicated his poem, would think that the study of the Epicurean or atomic theory was impious.[43]

[38] See H. W. Haggard, *Devils, Drugs, and Doctors* (Harper and Brothers, New York and London, 1929), p. 117.

[39] Dr. Simpson presented his case in the pamphlet referred to on p. 168. A brief summary is given by H. L. Gordon, *op. cit.*, pp. 125–129, and by H. W. Haggard, *op. cit.*, pp. 108–112.

[40] Genesis 3.19. [41] *Ibid.* 3.18. [42] *Ibid.* 2.21.

[43] *De Rerum Natura* 1.80–82:

> "Illud in his rebus vereor, ne forte rearis
> Inpia te rationis inire elementa viamque
> Indugredi sceleris. . . ."

On this passage see Paul Shorey, "Note on Lucretius 1.80," *Class. Phil.*, 17 : 360–361.

Many centuries later there was considerable feeling against research among the contemporaries of Erasmus. Some of them accused of impiety investigators who pried into the works of the

Fig. 4. The birth of Eve from Adam's spare rib (see text, p. 172)
(Reproduced from the *Nuremberg Chronicle*, 1493)

Creator, but neglected the Creator himself. Astronomers, for instance, were regarded as out of their minds for curiously searching into things that were above them figuratively as well as

literally.[44] At the present time some church officials of high standing see "the ghastly apparition of atheism" lurking behind Einstein's theory of space and time.

DESECRATIONS OF GOD'S OWN IMAGE

The record in Genesis that God created man in his own image has exercised much influence on the thought and customs of Christians.[45] In fact, as early as Genesis 9.6 this is given as a justification for blood vengeance: "Whoso sheddeth man's blood, by man shall his blood be shed: for in the image of God made he man."

Tertullian [46] thinks it unseemly for the likeness and handiwork of God to lie exposed to beasts and birds of prey. For that reason the corpse was returned to the earth from which it came.

Today there are many who refuse to subject to flames a body that was "once the living temple of God." In fact, the attitude of one powerful modern church toward cremation is distinctly hostile. Undoubtedly the same feeling existed among the early Christians, although I have not succeeded in finding an explicit statement to that effect.[47]

The prevalent reason for concern about the fate of the mortal body was the belief that it would rise again in the

[44] Erasmus, *Antibarbarorum Liber:* "Astrologos delirare dicunt quod ea qu[a]e supra se sunt curiosi scrutentur: physicos impietatis accusant quod divina rimanentes opera ipsum rerum opificem negligunt." This passage can be most readily found in A. Hyma, *The Youth of Erasmus* (Vol. 10 in the series in History and Political Science, University of Michigan, Ann Arbor, 1931), p. 295. According to Xenophon, *Mem.* 1.1.11–15, Socrates thought it foolish to inquire about heavenly phenomena. Cf. Edward Young, *Night Thoughts*, 9.771: "An undevout astronomer is mad."

[45] Cf. W. Lowrie, *Monuments of the Early Church* (The Macmillan Co., New York, 1906), p. 41: "There is no doubt that the practice of inhumation was prescribed by the new faith and obligatory upon all the faithful; with a naïve conception of the doctrine of the Resurrection cremation seemed irreconcilable. There was also a strong repulsion to burial amongst heathen."

[46] *Div. Inst.* 6.12 (Migne, *Patrol. Lat.*, Vol. 6, Col. 682): "Non ergo patiemur figuram et figmentum Dei feris ac volucribus in praedam iacere: sed reddemus id terrae unde ortum est."

[47] Cf. Tertullian, *De Animis* 51 (Migne, *op. cit.*, Vol. 2, Cols. 781–782): "Est hoc enim in opinione quorumdam est. Praeterea nec ignibus funerandum aiunt, parcentes superfluo animae."

flesh.[48] Early Christian writers assert and reassert that the disposition of the body does not matter,[49] but this reiteration shows that they were trying to combat a deep-seated conviction that it did. There must have been legions of converts incapable of understanding how a body that had been cremated could rise again in the flesh at the Resurrection.

Naturally the belief that the body will rise again causes much opposition to dissection. Dr. William Shippen, Jr., who gave instruction in dissection in Philadelphia as early as 1762 was attacked on more than one occasion.[50]

"The most violent outburst against dissection occurred in New York City in the so-called Doctors' Mob of April 1788. On that day Dr. Richard Bayle, working in the laboratory of the Hospital Society, observed a small boy peering in at one of the windows. In a spirit of medical humor he waved the arm of a cadaver at the boy to frighten him away. The exaggerated tales told by the terrified boy resulted in the collection of a mob which stormed the building and burned the anatomical collection. The physicians at the hospital took refuge in the jail. The jail was attacked and it was necessary to call out the militia in order to quell the disturbance. In the encounter that followed, seven of the rioters were killed and several more were seriously wounded. The following year the Legislature of New York authorized the

[48] Compare, for example, Tert., *De Res. Carnis* 63 (Migne, *op. cit.*, Vol. 2, Col. 933): "Resurget igitur caro et quidem omnis et quidem ipsa et quidem integra."

[49] A passage often quoted is Minucius Felix, *Octavius* 34.9–11: "Ceterum quis tam stultus aut brutus est ut audeat repugnare hominem a deo, ut primum potuisse fingi, ita posse denuo reformari. . . . Corpus omne sive arescit in pulverem sive in umorem solvitur vel in cinerem comprimitur vel in nidorem tenuatur, subducitur nobis, sed deo elementorum custodi reservatur. Nec, ut creditis, ullum damnum sepulturae timemus, sed veterem et meliorem consuetudinem humandi frequentamus. Vide adeo quam in solacium nostri resurrectionem futuram omnis natura meditetur." St. Augustine, *De Civ. Dei* 1.12–13 (Migne, *op. cit.*, Vol. 41, Cols. 26–28) is likewise emphatic is stating that it does not matter what happens to the body. At Lyons in 177 A.D. bodies of Christian martyrs were cremated and their ashes scattered over the Rhone River in order to destroy all hope of resurrection. See Eusebius, *Historia Ecclesiastica* 5.1 (Migne, *Patrol. Graec.*, Vol. 20, Cols. 433–434).

[50] Haggard, *op. cit.*, pp. 151, 153: cf. p. 149.

dissection of the bodies of persons executed for burglary, arson, and murder." [51]

Belief in the resurrection of the body is sometimes naïvely expressed today. The negroes of Julia Peterkin's *Scarlet Sister Mary* [52] take care to straighten out the legs of a cripple before his corpse is laid to rest. The deceased was not to be a cripple in heaven. In Heywood's *Porgy* [53] one negro says to another with the utmost surprise: "Yuh ain't keer whedder yuh is cut up an' scatter, 'stead of bein' bury in Gawd own grabeyard?"

In the quotation from *Porgy* the idea of the resurrection is not necessarily in the speaker's mind, but we know that the study of anatomy by physicians was greatly hindered in this country by religious objections to dissection. A passage somewhat similar in spirit to the one just given occurs in Paul de Kruif's account in *The Hunger Fighters* [54] of the search for the germ of tularemia:

"On the 18th of August R— S — closed his eyes — that from the first day had been so tired, too tired to hold open — for the last time. And the wife told urgent imploring Francis: 'Yes, if it's to find out about it, you may go ahead.' Charles and Francis might go in with the undertaker — 'provided they took nothing away. . . .'"

Although some Christian Fathers maintained that only man was created in the image of God,[55] none denied that God made

[51] Haggard, *op. cit.*, p. 153. On denunciation of surgery see Andrew D. White, *op. cit.*, 2 : 34, note. The Egyptians, too, attached great sanctity to the body and did not tolerate dissection by doctors. There was such an aversion even to making the incisions necessary to permit embalming that the man who ripped open the body (*paraschistes*) was execrated. As soon as he performed his task he took to his heels to escape a volley of stones thrown by those present. A volley of imprecations likewise pursued him, so that all the pollution might be upon him alone. The story is told by Diodorus Siculus, 1.91. Pliny the Elder, 28.5, likewise says that it is impious to examine the entrails of human beings.

[52] Page 27 (Grosset & Dunlap. Copyright by the Bobbs-Merrill Co., Indianapolis, 1928).

[53] Page 98 (George H. Doran Co., New York, 1925).

[54] Page 98 (Harcourt, Brace and Co., New York, 1928).

[55] In commenting on I Corinthians 11.7: "For a man indeed ought not to cover his head, forasmuch as he is the image and glory of God: but the woman is the glory of the man," St. Ambrose says: "Vir enim ad imaginem Dei factus est, non mulier." The quotation may be found in Migne, *Patrologia Latina*, Vol. 17, Col. 240. The same general idea occurs in Col. 436 of the same volume.

woman. Since she was God's handiwork, it was presumptuous in her to try to correct or improve it. Cyprian [56] exhorts women to remain as the hands of their Maker fashioned them. They were not to befoul their faces and necks (with cosmetics), nor dye their hair, nor inflict "wounds" upon their ears, nor wear bracelets, necklaces and anklets. Jerome [57] regards it as expressly against the precept of God for women to paint themselves frequently with purple, ceruse and stibium. Other Christian leaders held similar views.

No originality can be claimed, therefore, for the numerous writers of the fifteenth and sixteenth centuries who condemn face-painting and adornment as an insult to God's workmanship.[58] A typical passage occurs in *The Plain Mans Pathway to Heaven* (1601), by Arthur Dent:

"What say you then to painting of faces, dying of haire, wearing of Periwigges and other haire? And what say you to our artificial women, which will be better than God made them? They like not his handy-works; they will mend it, and have other complexion, other faces, other haire, other bones, other breasts and other bellies than God made them."

Naturally the pulpit too found this general subject a fertile theme. In the "Sermon against Excess of Apparel," in the Church *Homilies*,[59] a sixteenth-century Tertullian was much concerned about the practices of some women of his day:

St. Augustine, however, says that woman too is made in the image of God. See Migne, *op. cit.*, Vol. 34, Col. 294.

[56] *De Habitu Virginum* 21 (Migne, *op. cit.*, Vol. 4, Col. 473): "Estote tales quales vos Deus artifex fecit: estote tales quales vos manus Patris instituit; maneat in vobis facies incorrupta, cervix pura, forma sincera. Non inferantur auribus vulnera, nec brachia includat aut colla de armillis et monilibus catena pretiosa; sint a compedibus aureis pedes liberi, crines nullo colore fucati, oculi conspiciendo Deo digni."

[57] *Epistola* 108.15 (Migne, *op. cit.*, Vol. 22, Col. 891): "Turpanda est facies quam contra Dei praeceptum purpurisso et cerussa et stibio saepe depinxi."

[58] Many examples are given by M. P. Tilley, "'I Have Heard of Your Paintings Too' (*Hamlet* III, 1, 148)," *Review of English Studies*, 5 (1929): 312–317. To this paper I am indebted for the quotations from Arthur Dent and the Church *Homilies*, the second of which, however, was added by the editor of the journal.

[59] Second Tome, 1563, p. 117v. I have not been able to get access to this publication.

"Who can paynt her face, and curle her heere, and chaunge it into an vnnatural coloure, but therein doth worke reprofe to her maker, who made her? As though she coulde make her selfe more comely, than GOD hath appoynted the measure of her beautie. What do these women, but go about to refourme that whiche God hath made? not knowing that all thinges naturall, is the worke of God: and thynges disguysed, vnnaturall bee the workes of the deuyll."

SLAVERY

In addition to the curses heaped upon Adam and Eve, there was another that affected only the black race. Because of what Ham had done Noah said: "Cursed be Canaan; a servant of servants shall he be unto his brethren." [60] Nearly a century ago a clergyman wrote: "I remember when many pious people had great scruples about endeavouring to emancipate the negroes, on the ground that they were the descendants of Ham, on whom the curse of perpetual slavery had been pronounced." [61]

ANIMAL AND PLANT LIFE

Religious superstition plays a part in connection with lower forms of life, which are also God's creatures and for that reason should not be killed. In Julia Peterkin's *Black April* [62] Big Sue says:

"April wouldn' rest not till e pizened dem boll-evils. I couldn' hardly sleep in de night all las' summer fo' dem machines a-zoonin'. Everybody was scared to look out de door whilst April an' Sherry was gwine round de fields. De pizen dust was same as a fog. Lawd! I slept wid my head under a quilt ev'y night. April better had left dem boll-evils right whe' Gawd put 'em. I don' kill no kinder bugs exceptin' spiders. Not me! Fightin' Gawd's business'll git you in trouble. April's got off light so far, but e better quit

[60] Genesis 9.25. [61] Page 61 of work cited in note 26.

[62] Page 247. April "could make the men do almost anything else, but he'd never get them to poison boll-weevils. They knew better than to fight Providence. April wasn't God. No" (*ibid.*, p. 215). "But I tell you, I sho' don' believe in pizenin' 'em. No, suh! Gawd sent dem here an' we better leave dem lone. If I was you, I wouldn't run no pizen machine" (*ibid.*, p. 149). See also p. 208.

tryin' to do all de crazy t'ings de white people says do. E sho' better! Bad luck's been hangin' round ever since dat radio-machine at de Big House started hollerin' an' cryin' an' singin' year befo' last. People ain' got no business tryin' to be Gawd. Not black people anyways. Let de white people go on. Dey is gwine to hell anyhow!"

In a book written to sell rather than to add to the world's store of facts a sailor is represented as being shocked when he finds he is dissecting a female shark with young. No man would ever willingly kill a female thing, for, as the sailor explains, "Givin' life is part of the Creator's job." [63]

Another strange nautical superstition is related by Victor Hugo in *Toilers of the Sea*.[64] Of Gilliatt, the owner of an old sloop, he says:

"He brought home heavy takes of fish; but people said that his medlar branch was always hanging up in the boat. No one had ever seen this branch, but every one believed in its existence.

"When he had more fish than he wanted he did not sell it, but gave it away.

"The poor people took his gifts, but were little grateful; for they knew the secret of his medlar branch. Such devices cannot be permitted. It is unlawful to trick the sea out of its treasures."

Plants too are part of God's creation and hence Luther Burbank's efforts to modify them aroused a storm of criticism, as he himself tells us: [65]

". . . I was preached about, talked at, written, telegraphed, scolded, abused, and even vilified: the more extreme of my critics

[63] Joan Lowell, *Cradle of the Deep* (Simon and Schuster, New York, 1929) p. 83.

[64] 1: 40 (edition cited in note 14).

[65] Luther Burbank, with William Hall, *The Harvest of the Years* (Houghton, Mifflin Co., Boston, 1927), p. 77.

Of a report that the Department of Agriculture was experimenting with a puckerless persimmon the Atlanta *Constitution* once said, in a jocose mood: "We object to the spread of the sugar-coated idea. It is one of the functions of the persimmon to pucker." The editor of the *Moody Monthly* grasped at this opportunity to moralize and added: "So may it be said it is one of the functions of the Christian life to know trial, for 'we must through much tribulation enter into the Kingdom of God' (Acts xiv. 22)." This story is told in characteristic fashion in *The American Mercury*, January, 1929, p. 110.

said that I was setting myself up as a competitor of Omnipotence, and the mildest of them called me a falsifier. One preacher inveigled me into his church, had me seated in a front pew and then worked up a trap for me by which I had to say just what I believed as to the truth of natural laws behind all life and what I disbelieved as to the truth of metaphysical and superstitious theories concerning creation. When he had me, as he thought, in a fine bag, with the draw-strings pulled, he proceeded to berate me in good old orthodox style and ended by offering a prayer for my awakening."

THE THUNDERBOLT

In pagan antiquity the control of the elements was naturally a prerogative of Zeus and his punishment of Prometheus for stealing fire from heaven is the best classical analogue to God's visitation upon Adam and his mate for eating of the forbidden fruit.

Zeus, who thundered and snowed and rained, was sometimes generous enough to permit other gods to exercise control of the weather, but retribution was sure when mere man tried to create thunder and lightning.

"For imitating lightning by torches thrown skyward and thunder by driving chariots over a bronze bridge, Salmoneus was doomed to cruel punishments in Hades.[66] Dionysius of Halicarnassus [67] records for us the fate of Allodius, an Alban king whom the gods hated. Scorning the divine powers, he imitated thunder and lightning with the idea of terrifying mankind into the belief that he himself was a god. To punish him, tempests and thunderbolts crashed down upon his dwelling, the Alban Lake rose to an unwonted height, and he himself was overwhelmed with all his house. Whenever the depths of the lake were undisturbed, the ruins of porticoes and other traces of a dwelling were visible." [68]

A few of the ancients did manage to free themselves from fear

[66] Verg., *Aen.* 6.585–586; Val. Flacc. 1.662; Hyg., *Fab.* 61; Apollod., *Bibl.* 1.9.7.

[67] *Antiq. Rom.* 1.71. For other references to this story and for a discussion of it, see K. F. Smith, "On a Legend of the Alban Lake Told by Dionysius of Halicarnassus," *Am. Journ. Phil.*, 16 : 203–210.

[68] This paragraph is quoted from one of my own papers in *The Classical Weekly*, 18 : 157.

of the thunderbolt. During the troublous year of 167 B.C., when the Rhodians were trying to prevent a declaration of war by Rome, a Rhodian emissary admitted that some of his countrymen might despise the Romans and went on to say: "For some chide even the gods with rather bold words and we have never heard that anyone has been struck by a bolt for that reason." [69]

In *The Invisible World* [70] Bishop Joseph Hall gives proof that the Christian deity resents even smaller offences:

"A Master of Philosophy travelling with others on the way, when a fearful Thunder Storm arose, check'd the Fear of his Fellows, and discours'd to them of the Natural Reasons of that Uproar in the Clouds, and those sudden Flashes wherewith they seem'd (out of the Ignorance of Causes) to be too much affrighted; in the midst of his Philosophical Discourse, he was struck dead with that dreadful eruption which he slighted: What could this be but the Finger of that God, who will have his Works rather entertain'd with Wonder and Trembling, than with curious Scanning?" [71]

Manilius [72] says that "Reason (science) tore from Jove the thunderbolt and the power of thundering." We have seen that Christianity has restored the bolt to its deity. We still see "the hand of God" in the striking of a building or person by a bolt.

PRESUMPTION

In commenting on the failure of the Persian invasion of Greece Herodotus [73] remarks that only god may be proud. The idea runs through Greek literature. In explaining his own downfall Croesus says: "I did not know myself," [74] i.e. "I did not know that I

[69] Livy 45.23.19. [70] Section VI.

[71] This passage is quoted by W. E. H. Lecky, *History of European Morals from Augustus to Charlemagne* (D. Appleton and Co., New York and London, 1929), 1 : 360, note 2. It may be found, in all the glory of its capitals, in *The Works of the Right Reverend Father in God, Joseph Hall, Lord Bishop of Norwich* (London, 1738), Tome 2, p. 403.

[72] *Astron.* 1.104: "Ratio / Eripuitque Jovi fulmen viresque tonandi."

[73] 7.10.5: *οὐ γὰρ ἐᾷ φρονέειν μέγα ὁ θεὸς ἄλλον ἢ ἑωυτόν.*

[74] Xen., *Cyrop.* 7.2.23. See Chapter IV, "Γνῶθι Σεαυτόν in Greek and Latin Literature," in E. G. Wilkins, *The Delphic Maxims in Literature* (University of Chicago Press, Chicago, 1929).

was only human." The idea of Nemesis is found in many places today, even among negroes. Big Sue, whom I have already quoted from *Black April*, says (p. 250, cf. 165): "Gawd made Heaven fo' de humble, Uncle Bill. Hell's de place where de proudful goes. When a man, white or black, gits to trustin' to his own strength, 'stead o' Gawd's, e is done-for, sho' as you' born."

Another aspect of the belief in Nemesis is to be found in Bayard Taylor's *The Story of Kennett* (Chap. XVII), in which a girl says to her lover:

"Please, Gilbert, don't always talk so certainly of what isn't over and settled! It makes me fearsome, so to take Providence for granted beforehand. I don't think the Lord likes it, for I've often noticed that it brings disappointment; and I'd rather be humble and submissive in heart, the better to deserve our good fortune when it comes." [75]

In "Domsie," one of the stories of Ian Maclaren's *Beside the Bonnie Brier Bush* the following reflection is addressed to the mother of a boy who came home to die after winning high honors in college and receiving much praise from relatives and others: "Ay, ay, it's an awfu' lesson, Marget, no to mak' idols o' our bairns, for that's naethin' else than provokin' the Almichty."

The next paragraph of the story is in the same vein: "It was at this point that Marget gave way and scandalized Drumtochty, which held that obtrusive prosperity was an irresistible provocation of the higher powers, and that a skilful depreciation of our children was a policy of safety."

BREAKING THE SABBATH

Another form of transgressing upon the divine domain is working on the Sabbath, since the Sabbath day is the Lord's. In several of the works of Gregory of Tours there are very curious examples of punishment for this offence, the most common of which was the rigid contraction of the fingers and hands about the implements they grasped.

[75] Sisygambis had a somewhat similar feeling at Arbela. When the Persians about her were elated by the initial reports that Darius had conquered, she remained stolid and impassive. Curtius, 4.5.10–11, attributes her demeanor to a fear that she would provoke Fortune by joy.

The hands of a man who made a key on the Sabbath became tightly clenched and his fingers pressed into his palms, so that he could not open a door.[76] A farmer on his way to church on Easter Sunday, seeing cattle grazing in his crops and fearing that he should lose his year's work, took an ax and began to cut branches to protect his fields. One of his hands contracted about a limb and he could not release it.[77] A club stuck fast to one hand of a man who ground grain on Easter Sunday. Cutting it off on each side of the afflicted hand he hastened to church in quest of a miraculous remedy.[78] Other persons were punished in somewhat similar fashion for plowing,[79] setting hedges,[80] combing hair [81] and doing similar things.[82]

A man who tried to get his hay in before an impending rainstorm on the Lord's Day felt in one foot a burning pain which forced him to stop. After mass had been said he again yoked his oxen and hastened to finish his task, but suddenly a pain shot through his eyes just as if they had been pierced by thorns.[83] Desecration of the Sabbath was also requited by bolts from heaven.[84]

Most of these unfortunate victims were relieved when they penitently sought divine forgiveness and aid at churches.

In modern times divine opposition to working on Sunday has been manifested in other ways.

"In the river of Tweed, which runs by Barwicke, are taken by Fishermen that dwell there infinite numbers of fresh Salmons, so that many households and families are relieved by the profit of that fishing; but (how long since I know not) there was an order that no man or boy whatsoever should fish upon a Sunday. This order continued long amongst them till, some eight or nine weeks before Michaelmas last, on a Sunday the Salmons plaid in such

[76] Gregory of Tours, *De Miraculis Sancti Juliani*, 3.7.
[77] Gregory, *Vitae Patrum*, 15.3.
[78] Gregory, *De Miraculis Sancti Martini*, 3.3.
[79] Gregory, *De Miraculis Sancti Juliani*, 11.
[80] Gregory, *De Miraculis Sancti Martini*, 3.29, 45.
[81] Gregory, *Vitae Patrum*, 7.5.
[82] Gregory, *De Gloria Martyrum*, 1.16; *De Miraculis Sancti Martini*, 3.55: cf. 2.57.
[83] *Ibid.* 4.45. [84] Gregory, *Historia Francorum*, 10.30.

great abundance in the River, that some of the Fishermen (contrary to God's lawe and their own order) took boates and nettes and fished and caught three hundred Salmons, but from that time until Michaelmas day that I was there, which was nine weeks, and heard the report of it and saw the poor people's lamentations, they had not seen one Salmon in the river, and some of them were in despair that they should never see any more there; affirming it to be God's Judgement upon them for the prophanation of the Sabbath." [85]

In the early days of railroads there was much hostility, both human and divine, to running trains on Sunday.

". . . One gentleman, by courtesy termed reverend, called all railway excursions on Sunday, 'trips to hell, at seven shillings and sixpence per head.' Awful denunciations were uttered on the sin of enjoying the Sabbath. Hand-bills, of which the following is a copy, disgraceful to the cause they were meant to serve, and disreputable to those who circulated them, were sent about the streets, and thrust into the wayfarers' hand: —

"'Solemn warning for Sabbath-breakers! God coming in judgment!!' so ran the Christian document, 'as revealed by the sudden destruction of nearly one hundred immortal beings on the Paris and Versailles railway, on Sabbath the 8th instant; [86] and also in the destruction by fire of the Sabbath-breaking town of Hamburgh!'" [87]

In a pamphlet called "Railroads and the Sabbath," Second Document of the New York Sabbath Committee (New York, 1858),[88] there occur the following paragraphs:

[85] Taylor, *Pennyles Pilgrimage*, as quoted in V. C. Lean's *Collectanea: Collections of Proverbs (English & Foreign), Folk Lore, and Superstitions, also Compilations towards Dictionaries of Proverbial Phrases and Words, old and disused* (Bristol and London, 1902–4), 2 (Part I) : 258–259. On page 258 Lean gives the following quotation from Holdsworth, *Deep Sea Fishing* (London, 1878), p. 214: "The herring-fishery is said to have disappeared from Guernsey since it was followed on a Sunday in 1830."

[86] 1842 (or *circa*).

[87] John Francis, *A History of the English Railway: Its Social Relations and Revelations. 1820–1845* (Longman, Brown, Green and Longmans, London, 1851), 2 : 42–43.

[88] A copy of this tract is in the Transportation Library of the University of Michigan.

"We would, then, respectfully, but with all the earnestness of men who associate the Sabbath with the creation and redemption of the world, and with their personal hopes and future prospects, *urge the entire cessation of needless secular labor on our thoroughfares on the Christian Sabbath:*

"Because *it is a sacred day.* The Word and Example of God have 'sanctified it' from the dawn of time. The Decalogue hallowed it forever. The Saviour of the world confirmed and illustrated its universal obligation and its humane intent, in divine teachings and by miraculous power. His Resurrection is commemorated by it. It is 'the Lord's day,' 'made for' the rest and worship of 'man.' He who made it guards it: and to profane it is to contend with its Author."

A PREROGATIVE OF ALLAH

The strangest, perhaps, of my examples of divine prerogatives of deity is the one attributed to Allah by the Mozabites of Algeria:

"All their cities are crowned with a mosque from which there rises a slender minaret curiously shaped and carved. In its design anything approaching a straight line is deliberately avoided, for Allah alone can make a line straight, and it would be presumptuous for man to usurp his prerogative." [89]

Most of my examples of transgressions upon the divine domain have been gathered during casual reading. They represent many centuries and many countries, but those that are modern in point of time are ancient in spirit. Just as these "old curiosity shops," our bodies, contain many vestigial remains of the physical constitution of men of old, so our beliefs may preserve survivals from a remote antiquity. Habits of mind may persist. Strabo's statement (1.2.8) that every illiterate and uninstructed man is yet a child and takes delight in fable is still true.

I believe, therefore, that the ideas recorded in this paper reveal an attitude of mind which was once prevalent rather than exceptional. In antiquity it was no easy matter to transfer phenomena

[89] H. Warner Allen, *The Illustrated London News* 176 (1930) : 286. One of the cities is illustrated on page 287.

from the realm of superstition and superstitious religion to natural law. It is not strange that Lucretius,[90] Vergil,[91] Pliny, Seneca and other writers praise those who had the insight to break away from the intellectual thraldom of the past and to awaken mankind to the possibilities of a new interpretation of the universe.

In the Hall of Fame, beneath the bust of Maria Mitchell, who discovered a comet in 1847, is the inscription: "Every formula which expresses a law of nature is a hymn of praise to God." The knowledge that the divine domain may be explored without trespassing, though it is not possessed by all state legislatures, is one of the greatest achievements of the centuries.

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[90] See, for example, 1.62–71 (H. A. J. Munro's translation):

"When human life to view lay foully prostrate upon earth crushed down under the weight of religion, who shewed her head from the quarters of heaven with hideous aspect lowering upon mortals, a man of Greece ventured first to lift up his mortal eyes to her face and first to withstand her to her face. Him neither story of gods nor thunderbolts nor heaven with threatening roar could quell, but only stirred up the more the eager courage of his soul, filling him with desire to be the first to burst the fast bars of nature's portals."

[91] See, for example, *Georgics* 2.490–492:

"Felix, qui potuit rerum cognoscere causas,
Atque metus omnis et inexorabile fatum
Subiecit pedibus strepitumque Acherontis avari!"

THE CEREMONIAL BUFFOON OF THE AMERICAN INDIAN

JULIAN H. STEWARD

THOSE who are accustomed to thinking of the American Indian as sober and stone-faced will be surprised to learn that he not only laughed as frequently as his white-skinned cousin, but actually introduced into his most sacred ceremonies a comedian whose primary business was to delight the spectators.

The subject of laughter has long been an open field for all manner of students of human nature. Rarely have two bagged the same game. All have made the serious mistake of attempting to formulate a type stimulus to laughter from the humor of a single culture, namely, our Euro-American civilization, although a few rash theorists have fancied a "racial" difference in what things are funny.

It cannot be supposed that an anthropological approach to laughter can solve all the subtleties of this manifestly difficult problem. A review of humor in distinctly different cultures, however, may provide a least common denominator to the humor of the world and thus clear the ground for sounder psychological theorizing. The problem then may be restated in anthropological terms, "To what extent does culture predetermine what is laughable?"

The American Indian furnishes abundant material for a tentative answer to this problem, but it must be remembered that our attention is to be centered upon the institutionalized humor exhibited by the ceremonial buffoon. Humor of everyday occurrence, to be sure, was much in evidence in native life, but this is not available for our purpose because observers have paid little attention to it and made less record of it. The antics of the buffoon, on the other hand, have been well described.

The ceremonial buffoon, however, did not have universal occur-

Map 2. Distribution of the ceremonial buffoon in North America. Full lines indicate the presence of a strongly developed "clown complex"; broken lines, that the complex is weakened or that adequate data are not available.

rence in North America. The idea of setting aside one person or a group of persons to act as both sergeant-at-arms and comedian seems to have originated, as an historical complex, but once, either in Mexico or among the ancestors of the Pueblo tribes of New

Mexico and Arizona, and from its early source to have diffused to several culture areas of North America. The clown was especially prominent in the Southwest, the Plains Area, California and on the Northwest Coast.[1] What diffused, however, was the idea of setting aside a special person as buffoon, not a particular set of notions about the comic. In other words, a "pattern" diffused whose content was to be filled in somewhat differently in each culture area.

A classification of the themes of humor employed by the ceremonial buffoon permits a twofold division: (1) traits of comedy common to all peoples regardless of culture, and (2) traits of comedy peculiar to each culture area.

COMIC THEMES OF UNIVERSAL OCCURRENCE

The greater number of the comic devices employed by the clowns of native America are based upon situations which are regarded as humorous in every culture. Although as employed by the Indians these devices are rude and smack strongly of the soil and are not comparable to the fine-spun themes of the highly intellectualized European comedies, they are nevertheless basic in all cultures. They center about matters which possess the greatest emotional appeal in any cultural group; they are "human interest" themes.

These may be grouped in four main categories: (1) themes of humor in which sacred and vitally important ceremonies and sometimes persons are ridiculed and burlesqued, or, at times, themes of the nature of practical jokes, which riotously disregard those folkways and mores which are so essential to the smooth functioning of society; (2) themes of humor based upon sex and obscenity; (3) themes based upon sickness, sorrow, misfortune, etc., and important activities in daily life; (4) caricature and burlesque of foreigners.

1. Burlesque of the sacred

This class of comic situations comprises one of the most common themes of buffoonery. The clown is the person *par excellence* who is privileged to ridicule, burlesque and defile the most sacred and important ceremonies, persons and customs. He is licensed to be-

[1] See Map 2 for the distribution of the clown.

have as no ordinary mortal would dream of behaving. He is held accountable for nothing. In his transgression of custom lies much of his comedy. Those mores which are ordinarily observed most rigorously and which are held in great esteem are the subjects of the most pleasurable comedy. As Bandelier says of the Koshare, the "delight makers" of the Pueblo Indians, "nothing is sacred; all things are permitted so long as they contribute delight to the tribe." [2]

A few illustrations from the wealth of material at our disposal will exhibit the clown in this rôle in different cultures.

Among the Pueblo Indians of the Southwest, clowns are present at the god-impersonating dances to perform comic side-plays on the central theme of the ceremony. They burlesque the *kachina* dancers, dancing out of time, stumbling, grimacing and doing things ordinarily taboo. At a Jemez Pueblo dance a clown is reported to have irreverently sprinkled his fellows with sand and ashes in imitation of the ceremonial sprinkling with corn-meal and pollen; [3] at Zuñi the Newekwe clown society speaks in Spanish or English before the gods, a thing strictly taboo to ordinary people. The latter once rigged up an imitation telephone and pretended to converse with the gods, although gods are not supposed to speak.[4] The Hopi Koyemsi or "Mudheads" perform separate dances of their own in ludicrous imitation of the *kachina* dancers. The clown of the Navajo Night Chant dance joins the masked dancers in a wholly erratic and unorthodox manner. He gets in their way, dances out of time and awkwardly, sits on the ground, rocking to and fro peering foolishly at people. When the other dancers have departed he continues dancing until he discovers his mistake and then runs after them. Sometimes he imitates the leader, trying to anticipate him in giving signals for the dance.[5] Even sacred sleight-of-hand performances are burlesqued so as to reveal the secrets.[6]

The buffoon of the religious dances of California performs in a similar manner. Among the Northwestern Maidu his chief stock-

[2] 1890*a*, p. 137.
[3] Reagan, 1915, pp. 423–427.
[4] Parsons, 1917, pp. 229–233.
[5] Matthews, 1902, pp. 150–151.
[6] Matthews, 1887, pp. 443–444.

in-trade is to parody the ceremonial leader and burlesque the dancers. He enters the dance house after the dancers have come in, munching food. The leader reprimands him and asks him to take part in the dance. A bantering dialogue ensues. Whenever the shaman tries to make a speech, the clown parodies his remarks. He steals tobacco and is again reprimanded. When he finally joins in the dance, he does so languidly, frequently stopping to eat.[7] In the Wintun Hesi ceremony, the acme of Wintun ceremonialism, the clown directs his comic assaults at the leader. "When the captain of the host village was singing as he marched slowly about the inside of the dance house, one of the clowns stationed himself before the captain and marched slowly backwards in step with him, while delivering joking remarks concerning the latter's ability to sing and the particular song he was voicing. This did not seem in the least to disconcert the singer who continued to sing in his gravest manner; but his song was not received with the usual seriousness." [8]

In general, the Northwest Coast religious concepts imposed a pattern of behavior on the buffoon which was too rigid to permit this type of clowning, but instances of this kind have been reported from the Quinault [9] and the tribes of eastern Puget Sound.[10]

The same thing was true in large measure of the clown of the Plains, as among the Cree,[11] Ojibway,[12] Arapaho,[13] and others, especially in the northern Plains, where the pattern was less clear-cut.

Even in Central America, where drama tended to be divorced from religious ceremonies, the Maya are said to have had at their feasts and entertainments jesters who were clever in mimicry and caricature and did not spare even the chief men,[14] while the priests of the Aztec sometimes contributed to the fun of religious ceremonies by blowing mud balls at the actors and praising or censuring the performances in a jocular manner.[15]

[7] Dixon, 1905, pp. 315–317.
[8] Barrett, 1919, p. 457.
[9] Olson, personal communication.
[10] Gunther, personal communication.
[11] Skinner, 1915, pp. 528–529.
[12] Skinner, 1914, pp. 494–504.
[13] Kroeber, 1907, p. 192.
[14] Bancroft, 2 : 711–712.
[15] *Ibid.*, 2 : 291–292.

That this type of humor is not unique in America is apparent at once from brief reflection on comic themes in our own culture. Even among other primitives it was prominent. Thus in Samoa a jester's dance is performed by men and women of rank to provide comic relief to the dance of the very sacred *taupo* (the woman of highest rank and divinity).[16] The African Masai dances had similar frivolity.[17] The primitive Konds of India actually permitted ridicule of the goddess to whom human sacrifice had been made.[18]

In the foregoing examples the keynote of the comedy is what is commonly called "comic relief." Indeed, in nearly every instance it is the very thing which is regarded with greatest reverence or respect which is ridiculed.

A great deal of ruffianism is also exhibited by clowns. Things and persons are not at all respected. The Zuñi Newekwe and Koyemshi indulge in all manner of acts of physical violence. The Hopi clowns have tussles, tormenting each other with cactus branches, stripping breech-clouts and such-like.[19] The Papago clowns visit people's houses, upsetting things,[20] and, like them, the Miwok clowns run about after dances, prying into houses and wrecking what they can lay hands upon.[21] The Cahuilla "funny man" of Southern California annoys people by throwing water on them or dropping live coals down their backs.[22] And in like manner the Huichol clowns of Mexico torment people with "botherations" and prevent their sleeping by shaking rattles near their ears, or by tugging at their clothing.[23]

To a very large extent, rowdyism characterized the clowns of the Northwest Coast. The Haida often greeted their feast guests at the shore, "playing pranks" with their baggage, bursting it open, and doing similar things, all of which the visitors "expected and were prepared for." [24] The Kwakiutl Fool dancers, when excited by their possessing spirits, ran about with lances, knives or clubs, hitting people, or in serious cases even stabbing and killing them. Disliking clean and beautiful things, they attempted to break,

[16] Mead, pp. 114–115.
[17] Barrett, personal communication.
[18] Chambers, 2: 266–270, from Elliot, *The Indian Village Feast.*
[19] Fewkes, 1898, pp. 293–294.
[20] Mason, 1920, pp. 17–23.
[21] Gifford, manuscript.
[22] Strong, 1929, p. 166.
[23] Lumholtz, 1907, pp. 185–186.
[24] Swanton, 1909, p. 168.

destroy and soil them.[25] The Nootka,[26] Bella Coola [27] and Haida [28] had clowns who behaved largely in this manner.

2. Humor of sex

The prominence of sex humor in our own Euro-American civilization need not be pressed. It is equally, sometimes more, prominent in American Indian cultures. The importance of sex humor is the inevitable result of the powerful biological sex drive. Closely associated are matters of obscenity and the excrementitious.

The Koshare and Newekwe societies of the Southwest are preeminently associated with sex. They are in fact specifically phallic societies. The Jemez clowns make advances toward women [29] and the Zuñi Koyemshi, who wear imitation penes,[30] encourage sex license during the Shalako ceremony.[31] The Hopi clowns, who are said to be very fond of women, caper with female impersonators. The Hehe's *kachina* mask, in fact, is decorated with phallic symbols.[32] Obscenity and handling of filth run riot in certain ceremonial occasions in the Southwest.

Among the non-Pueblo tribes of the Southwest there was also a considerable preoccupation with sex in the activities of the clown.

In California, among the Yokuts, obscene and pretended phallic advances toward young girls formed part of the stock-in-trade of the clown.[33] The Yuki clowns hold each other's privates in their frolics.[34]

Obscenity, although not prominent, was not lacking on the Northwest Coast. Elliot has described scatological practices of various groups of Alaskan Eskimo.[35] During a comic interlude of a Kwakiutl ceremony a man jests with a chief's daughter, making pointed references to sex.[36]

The clown in the Plains was much concerned with the phallic,

[25] Boas, 1897, pp. 468–471, 664.
[26] Sapir, 1911, pp. 22–27.
[27] Boas, 1892, p. 917; 1897, p. 469.
[28] Swanton, 1905, p. 173.
[29] Reagan, 1915, pp. 423–427.
[30] Parsons, 1917, pp. 321–322.
[31] Stevenson, 1904, pp. 224–227, 235–236, 276–277; Cushing, 1920, pp. 601–607; Parsons, 1917, pp. 187–188.
[32] Fewkes, 1900, pp. 128–129.
[33] Gayton, field notes.
[34] Kroeber, 1925, p. 186.
[35] Bourke, pp. 142, 207–209, 391–392.
[36] Boas, 1897, p. 546.

which constituted a frequent theme of humor. The Arapaho clown was permitted sex license and obscene behavior. His phallic activities were facilitated by the use of a root by means of which he magically paralyzed and thus secured the women of his fancy.[37] The Ponca clowns were said to crawl up and touch a woman's genitalia in full daylight,[38] and the Hidatsa clowns were permitted incest, despite the usual strength of the incest taboo.[39]

Among the Fox, east of the Plains, a mule dance in which a man imitating a stallion performs indecent antics was a great amusement. Other dances and songs of the Sauk and Fox were highly obscene.[40]

By the Eastern Dakota phallicism was intimately associated with the Heyoka complex.[41] The Heyoka clowns were believed to have great supernatural power which, among other things, enabled them to satisfy their libido. As part of the Winged Head complex, this belief runs eastward all the way to Maine.[42] Among the Iroquois and various tribes of the Southeast, certain dances furnished occasions for sex license.[43]

Themes of sex and obscenity were common in the ceremonies and performances of the tribes of Middle America.[44]

Lewdness was also highly typical of the humor of cultures other than those native to the new world. The Samoa jester's dance, for example, was in large measure salacious.[45] The Feast of Fools, which survived in Europe until the middle of the sixteenth century, included a licensed desecration of the church and riotous buffoonery which was largely of an obscene nature.[46] In fact D. M. Robinson has derived the earliest Greek comedies from the phallic songs of the Bacchic dancers and revellers.[47]

[37] Kroeber, 1907, pp. 188–189, 191–196.
[38] Skinner, 1915, p. 789.
[39] Lowie, 1913, pp. 284–290.
[40] Michelson, personal communication.
[41] Pond, p. 232.
[42] Speck, personal communication.
[43] Speck, 1907, pp. 138–140; 1909, pp. 129–130; 1911, pp. 204–205; Swanton, 1928, p. 534.
[44] Bourke, 1891, pp. 435–436; Brinton, pp. xxii–xxvii; xli–xliv.
[45] Mead, pp. 114–115.
[46] Bourke, pp. 11–23.
[47] In J. Hastings, *Encyclopaedia of Religion and Ethics*, *s.v.* Greek Drama.

3. Misfortune

This class of humor is based upon situations and activities which are fundamental to human existence and which are frequently sources of pain, trouble and unhappiness. The clown often pretends to be crippled, infirm or destitute. He is clad in rags and goes about as though starving, begging for food. He enacts scenes of household strife and marital difficulties. He burlesques activities of hunting and fishing, food-gathering and horticulture. Gluttony, too, is employed, for it is an exaggeration of an extremely important daily activity.

In the Southwest, the Jemez Koshare dress in rags, carry crooked wands and wear corn husks in their hair.[48] The clowns of the Jemez Piñon dance perform in rags, begging for food. One of these beggars is impersonated by the governor of the Pueblo.[49] A Navajo stunt on the last day of the Mountain Chant ceremony is the impersonation of a dull-witted, decrepit and short-sighted old man. He enters in a woefully ragged suit, carrying a crooked bow and misshapen arrows. He totters into the dance space, where he stumbles on a yucca plant and howls with pain. In his effort to find it, he lacerates himself thrice more, complaining in a weak shaky voice. When he has marked the spot and the way back to it, in an exaggerated imitation of the old Indian way of doing things, he goes off to find "his woman," and brings her back to pick the yucca fruit. Soon he returns with a tall, stalwart man, dressed to represent a hideous, absurd-looking old granny.[50]

The Southwestern clowns are strongly addicted to gluttony; in fact, the Hopi *kachina* Paiakyamu is called the "Hano glutton," [51] and the Jicarillo Apache clown wears festoons of bread around his neck.[52]

The California Maidu clown is represented as a lazy, stupid person. During the dance two men representing hunters enter. They ask the clown whether he has seen any deer. He answers that they may have gone by when he was asleep. At another time

[48] Goldfrank, 1927, pp. 53–55, 90–91, 93.
[49] Thompson, 1889, pp. 353–355.
[50] Matthews, 1887, pp. 440–443.
[51] Fewkes, 1903, p. 120, Pl. LVIII.
[52] Russell, 1898, p. 371.

this clown pretends blindness, which leads to absurd episodes. On still another occasion he staggers in with a bundle of splinters which he carries with prodigious effort, grunting and staggering. He spears a fish with so much vigor that the spear is driven entirely through it and then ten men are required to land it.[53]

On the Northwest Coast, the ceremonial perverseness of the Kwakiutl Fool dancer gives him something of a destitute character. He wears a costume of rags, but this is said to be because he dislikes clean and beautiful things, which he always attempts to destroy.[54]

In the Plains and East Woodland, rags were the common garb of the ceremonial buffoon, and begging a favorite amusement. The Cheyenne Contrary Society dressed in tatters.[55] The Winnebago clowns, shabbily clothed, begged for food, pretending to be impoverished and destitute.[56] The clowns of the Plains Cree, Plains Ojibway and Assiniboine were characteristically represented as poor and in need.[57] Even the Iroquois False Face Society dressed in rags and made begging tours.[58]

It is reported that in Central America the Aztec comedians commonly mimicked and ridiculed the deaf, lame, blind, deformed and ailing,[59] and during the feast to Tlaloc priests "dressed like merry-andrews," went from house to house begging food.[60] The "Pilatos" of the Totonac festival of Corpus Christi, like the "old man" of the dances of the northern part of Mexico, represents himself as poverty-stricken. He wears rags, a black derby and a wooden mask.[61]

4. Burlesque of strangers

The humorous quality of burlesque of foreigners lies in incongruity. It is a pleasurable break from conventional patterns which is not restrained by emotions of sympathy. These are usually

[53] Dixon, 1905, pp. 298, 304; Powers, pp. 310–312.
[54] Boas, 1897, pp. 469, 516. [55] Grinnell, 2 : 206.
[56] Radin, 1923, p. 384.
[57] Skinner, 1915, pp. 528–529; 1914, pp. 494–504; Lowie, 1909, pp. 62–66.
[58] Skinner, 1914, pp. 494–504; Smith, 1888, pp. 184–193.
[59] Bancroft, 2 : 291–292.
[60] Bancroft, 3 : 334–335, 339.
[61] Nuñez, pp. 191–199.

directed against white men who are ordinarily the subjects of greatest emotional feeling, whether fear, envy or contempt.

A characteristic Santo Domingo theme is the "bull and horse" ceremony, which depicts the first arrival of the white men, missionaries and traders, in ludicrously ragged costumes. A mock bull fight is held, followed by songs of "London Bridge is falling down" and "Good Night Ladies." At the end the "traders" produce a suitcase and the Indians buy from them with paper money.[62] A Santa Clara fiesta enacts the arrival of the United States soldiers in a covered wagon, their drunkenness, and finally their fight with the Navajo, in which they are worsted until Utes come to the rescue.[63] A Hopi Powamu ceremony of 1928 caricatured American white girls. The "*kachina* girls," impersonated by men, were dressed in an incongruous attire of skirts, riding boots, sombreros and six-shooters, and they carried vanity-boxes. The Navajo buffoon furnishes great amusement simply by wearing a great false mustache and an exaggerated imitation of spectacles and other belongings of the white neighbors.[64]

The California clown had less leaning toward this type of humor, but we must note that the Yurok burlesque of a Karok fleeing from vengeance after eloping with another man's wife is of this order,[65] and so is the custom of the Southern Maidu of burlesquing the dance of their northern neighbors.[66]

The best illustration from the Northwest Coast comes from the Kwakiutl. An interlude in a potlatch ceremony introduces four men dressed as police officers. They set up an American court, one acting as judge. A woman is arrested for being absent from the preceding part of the ceremony, tried and fined $70 worth of blankets, which is afterward distributed in her name as potlatch gifts. This episode was introduced in 1865 and had been continued up to the time of Professor Boas' visit in 1897.[67]

Of similar cast is the Winnebago dance in which buffoons caricature white men,[68] and the Iroquois New Year dance, in which

[62] Gaastra, p. 67.
[63] *El Palacio*, 10: 12, 1921, anonymous.
[64] Matthews, 1902, p. 433.
[65] Kroeber, 1925, pp. 58–60.
[66] Ralph Beales, personal communication.
[67] Boas, 1897, pp. 562–563.
[68] Chandler, personal communication.

there are imitations of white men skating, locomotives, and the like.[69] The same theme was common in Central America.[70]

CULTURALLY DETERMINED HUMOR

That there should be some cultural differences, even within cultures, in what is laughable, is to be expected. For while the type stimuli to laughter — the pleasurable relief, the incongruous, the caricature, etc. — are forms which are not dependent upon cultures, the concrete situations into which they are set vary a great deal. The incongruous, for example, depends upon local cultural traits and patterns. The native African chief bedecked in a top-hat is ludicrous to the European; to his African subject he is the personification of magnificence. For the European has been so conditioned to top-hats that this constitutes an incongruity, a conflict of meaning. The African is not so conditioned.

In general, however, the points in which laughter varies among groups of men are not so far reaching as those themes which are shared by all. It has been shown empirically that the universal themes of humor concern matters of greatest emotional interest, and these do not differ materially with culture. Humor that differs with culture is more likely to concern folk-ways and things of material culture.

A further factor, however, making for cultural difference in the humor which is expressed through the clown is that the clown is seldom purely a comedian. His non-comic duties have frequently affected his comic behavior. For he is in addition to comedian a member of some society whose duties may entail important curing, fertility or military functions. The influence of such factors will be elucidated in the following discussion.

The Southwest phallicism

It has already been demonstrated that phallicism and obscenity constitute universal themes of humor. It must be recognized, however, that these themes, which are particularly emphasized in the Southwest, are more prominent among American Indians than, for example, in our own Euro-American culture.

[69] Smith, 1888, pp. 184–193. [70] Bancroft, 2: 285–286.

Obscenity and scatology are carried to the extreme in the Koshare, Newekwe, Wöwöchim and Manzrau societies of the Southwest, and, to judge from their frequency, are major sources of humor. Funny as these are to the natives, however, they have elicited only emotions of repugnance and disgust from even the ethnologist. Here clearly is a definite cultural difference in humor, and the reason is not obscure.

The concept of fertility is, as Haeberlin [71] has shown, prominent in Pueblo thought and ceremonialism. Fertility has been essential to the very survival of the villages; the keynote of their ceremonies is taken from this necessity. As humor is likely to strike at those things which are of greatest importance, this has come to be the dominant note of Southwestern humor. Moreover, the foremost and oldest clowning societies, the Koshare and its derivatives, are concerned in their sober moments with fertility and rain-making rites. It is not surprising, then, that as clowns these societies repeat the serious themes in clowning fashion.

California

In California distinctive comic differences may also be attributed to general cultural differences. These depend upon the conditioning occasioned by the differences in the ceremonial functions of the clown and are shown for instance in the contrast between the clown of the Northwestern Maidu and Patwin and that of the Pomo and Yuki, or, in other words, between those tribes which had the Hesi ceremony and those which lacked the Hesi and stressed the secret or ghost society. In the former the clown served as speaker to the chief and was purely a mundane personage, not even resorting to disguises for his comedy. Among the Pomo and Yuki clowning was not set aside for special personages, but was carried on by men who were primarily ghost impersonators, secondarily comedians, and whose humorous aspect was merged with an unworldly character. The Patwin and Maidu clowns' performances seemed frankly ludicrous, avowedly for sheer entertainment. Among the Pomo and Patwin the clown was primarily an antinatural being, a ghost, and the grotesque dress, strange behavior

[71] 1916.

and contrary nature were as much an attempt actually to represent such a being as to produce a ludicrous impression. Moreover, within these tribes an atmosphere of sacred unnaturalness, even in regard to the buffoonery of the clowns, is attested by the fact that the audience was prohibited from laughing.

The traits of the Coyote type of clown are mainly to be attributed to Southwestern influence. In large measure, however, this portrayal has been exaggerated by the tricky, obscene characteristic of Coyote, which in western mythology has served to make coyote tales subjects of constant amusement. The Coyote clown represents, then, to a minor degree a cultural difference.

The Northwest Coast

The Northwest Coast has imposed a virile cultural pattern upon the activities of its clowning societies. The Kwakiutl Fool dancers are primarily a hereditary society, the members of which are possessed during the winter dance season by their spirits. This possession causes excitability, madness, unnatural behavior, and it is provoked by the members of the opposing moiety.[72] The behavior of possessed individuals causes general excitement rather than specific laughter. There is, however, some difference in the character of the madness of the various societies. The Fool dancers tend more toward the comic than the others, although it is not their chief aim. They, as well as the Cannibals and Bear dancers, are closely associated with war, and they carry weapons of war — a lance, knife and club. Their military character is also evident in their behavior. When supernaturally excited they attack people by throwing stones, hitting them with sticks, and, in serious cases, stabbing and killing them.[73] This of course is beyond the bounds of humor. In a sense it represents the trait of practical joking carried to a serious extreme, and this extreme follows from their character as a "possessed" military society.

There is, however, a certain humorous turn to the characterization of the Fool dancers. They are represented with enormous noses, in which lie their personalities and their power. Neophytes

[72] Boas, 1897, p. 420. [73] *Ibid.*, pp. 468–471.

to the society are initiated by being rubbed with mucous.[74] They possess a real Cyrano de Bergerac complex in regard to this organ. Any allusion to noses irritates them and to have their noses struck causes them to go out of their heads. When in a fury they do not dance, but run about like madmen, throwing things about, striking people and breaking things.[75] People irritate them by pulling or spitting on their noses.[76]

The Haida persons, who are "made *gagixit*," exhibit a madness comparable to that of the Kwakiutl Fool dancers. They rush about town, rolling over, running through people's houses, making fun of their canoes and crying through the woods. People do not venture out, and if anyone is caught in the woods, his clothes are torn off and his person ridiculed. They may pull canoes out of the water and break them. The *gagixit* may be caught. For example, on one occasion an inflated seal stomach was hung up and he was called. He came crying, "A ha, ha, ha," rolled under the stomach and went away. When he returned he was seized and taken to the dance house, where he later danced accompanied by spirit songs. At least part of the function of such individuals is to destroy property which the potlatching chief afterward pays for.[77]

The Plains: contrary behavior

In many respects the ceremonialism of the Plains stands in sharp contrast to that of the other areas considered in this paper. As the Plains tend more toward individual rites and interests, this important ceremonial setting does not permit the type of clown found elsewhere. Societies joined through visions, for example, had their private ceremonies. Public, communal ceremonies were less common. These rituals were in fulfilment of private promises, or to gain personal ends. They centered largely around visions in which the individual rather than the community sought benefits.

With such latitude in behavior and regalia as was permitted by the lack of rigid patterns in the Plains, it might seem that a great range of comic devices would have been possible. As a matter of

[74] *Ibid.*, pp. 468–469. [75] *Ibid.* [76] *Ibid.*, pp. 523, 545.
[77] Swanton, 1909, p. 173.

fact, the Plains clown was dominated and characterized by contrary speech and action. This is generally rationalized as the result of a vision, chiefly of thunder or lightning, which causes one to behave in an unnatural manner. The strength of this association with a vision and the peculiar nature of contrary speech and action brought this into great vogue as a comic device. At the same time the individualistic nature of Plains ceremonialism made it possible that it should also develop into aberrant forms in the military societies. For Plains ceremonialism permitted indefinite variations and vision-given ritual constantly recombined old elements.

Typical features of Plains ceremonialism are exhibited in the Dakota Heyoka society. This society was joined by a vision of thunder or of Wakinyan, and such a vision made one *heyoka*, or antinatural,[78] and largely governed his subsequent behavior.

The peculiar traits of the Heyoka have been explicitly and fully described for the Dakota. The desires and experiences even of the Heyoka deities are all contrary to nature. "In the winter they stand on the open prairie without clothing; in the summer they sit on knolls wrapped in buffalo robes and yet they are freezing." The initiation ceremony to the Heyoka society is somewhat stereotyped, but the outstanding feature is an antinatural trick, the boiling-water performance. In drawing meat from boiling water the performer's hand is protected by certain roots, probably the mallow. During the initiation ceremony the Heyoka members are present dressed as clowns and must act in a contrary manner.[79] Besides the boiling-water trick, the Heyoka may splash boiling water on their backs and legs, complaining that it is cold.[80] They exaggerate the unnatural atmosphere by singing individually and discordantly.[81]

The prominence of contrary behavior threw other comic devices into the background, but the essential point is that the members of the Heyoka were in grave danger of thunder and lightning if they did not perform these contrary ceremonies, so that they were clowns by the direst necessity, by the imperative demand of a vision.

Examples from other tribes will illustrate the predominance of

[78] Wissler, 1912, pp. 82–85.
[79] *Ibid.*
[80] Dorsey, 1894, p. 469.
[81] Lowie, 1913, pp. 113–116.

the contrary concept in Plains humor. The Ponca Heyoka were quite similar to those of the Dakota, but the Thanigratha, "Those-who-imitate-madmen," also contrary, were more purely clownish. They might, for example, ford a stream by stripping one leg and hopping across on the leg which was clad.[82]

The Cheyenne Contrary society is also controlled by this concept. Like the Heyoka, it is joined by people who fear thunder and lightning. The society lodge is constructed with the skin wrong side out and the poles outside the skin; the pipe used in the ceremony is assembled incorrectly; the members dress in rags, walk backward, reverse the sitting posture by lying on the ground with their feet up, and say the reverse of what they mean; they tumble about and dance clumsily.[83] They carry red bows and arrows which they use in reverse manner, and they dart about in an eccentric way "like lightning in a storm," for it is said that the "thunderstorm has with him people who act this way." [84]

The Plains Ojibway clown-doctors, Windigokan, combined the serious and humorous aspects of contrary behavior. They were contrary in their play, their warfare, and even in their curing. They too were foolhardy in war. On one occasion twelve of these clowns assembled with their leaders who said: "I am not going to war. I shall not kill Sioux. I shall not scalp four and let the rest escape. I shall go in the daytime." They departed that night and soon met a large body of Sioux. Instead of fleeing they danced until the Sioux, thinking them deities, made offerings to them. Suddenly they drew their weapons and killed four of the Sioux, frightening the remainder. After scalping the four enemies, the leader said: "Now my old men [they were all youths] you must not run home as fast as you can." On another occasion they performed as clowns, being terrified at stumps, fleeing from dogs and being thrown into spasms at drum beats.[85]

Summary

Those differences which exist between the comic practices of the various American Indian clowns follow in part from the differences

[82] Skinner, 1915*a*, p. 789.
[83] Grinnell, 2 : 204–210.
[84] *Ibid.*, p. 329.
[85] Skinner, 1914, pp. 500–505.

set up through different cultural values, in part from purely historical accidents. The emphasis in the Southwest on sex, obscenity and scatology arose from the supreme importance in this area of the concept of fertility. The unusual prominence of the same things among the nomads of the Southwest and tribes of California arose largely from a cultural connection with the Pueblo tribes. The importance of ceremonial madness on the Northwest Coast was the upshot of a peculiar turn of development and determined the basic character of the clown in that area, while the assignment of clowning to a military society further exaggerated the clown's obstreperous and violent behavior. In the Plains, the association of clowning with societies born of visions gave the organizations a typical Plains cast, while a historical accident which originated contrary behavior — probably in a single group — lent the societies their characteristic flavor.

CONCLUSIONS

The high degree of "psychic unity" of man in regard to things laughable is explainable in terms of similar conditioning under different cultures of an innate response. There is no evidence to demonstrate any differences between races in the unconditioned stimuli which produce laughter. All indications point to laughter as an innate response to pleasurable stimuli. To the extent, then, that different cultures find similar things comical, there has been a similar conditioning to things painful and pleasurable. This means simply that sickness, misfortune, poverty and the like, and physiological necessities affect all groups of men alike. They are equally charged with emotional interest and pleasurable or comic relief from them is everywhere sought.

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QUANTITATIVE ANALYSIS OF SOME OF THE FACTORS AFFECTING THE BIRTH-RATE IN FOURTEEN LARGE AMERICAN CITIES: A PRELIMINARY REPORT

ROBERT R. HORNER

THE total number of persons within a given area is a function of the birth-rate, the death-rate and the net rate of migration. But these three variables are not independent, for they are determined in their turn by more fundamental forces which are comparatively obscure. If we were to diagram these relationships which are determinants of the population, we might develop a chart more complex than the chemist's maze which illustrates the breaking down of coal tar. It is the purpose of this paper to ferret out, if possible, some of the factors which make the birth-rate what it is in a selected group of American cities which show considerable differences in the intensity of child-bearing and in qualitative characteristics.

The regions which will be examined are the following large communities: Detroit, Cleveland, Boston, Baltimore, Pittsburgh, Los Angeles, Buffalo, San Francisco, Milwaukee, Washington, Cincinnati, Minneapolis, Seattle and Indianapolis. Why these particular places? The fourteen range between the population limits of 300,000 and 1,000,000 persons. This seemed a rather handy pair of lines to draw, provided a sufficient number of cities could be included to make statistical investigation possible by the correlation method. Not all the cities in the stated range are included, however, for comparable birth statistics are available only for those local areas which have deigned to come within the United States Birth Registration area. This meant the elimination of Kansas City, New Orleans, Newark and St. Louis. The time under con-

sideration was also limited to the year 1920, for the report of 1930 was not available; and birth-rates begin to err in intercensus years, owing to the necessity for estimating the population base.

The method of analysis was to use figures of different sorts taken from various parts of the Fourteenth Census, the Census of Manufactures for 1919 and the Reports of the Birth Registration Area for 1920. Gross totals, modified totals, rates and ratios, and averages were used to typify conditions in the specific cities; and these were correlated with the birth-rate and with each other. Perhaps a general word should be said about correlations to make clearer their meaning. If two variables appear in a group of related objects, and if they vary in sympathy with each other, there is said to be correlation between them; that is, height and weight are two variable attributes in man, and generally a tall man weighs more than a short man, so that correlation is affirmed between height and weight in man. This is elementary. The device adopted to show the degree of correlation is the Pearsonian coefficient: $r = \frac{\Sigma \bar{x}\,\bar{y}}{n\sigma_x\sigma_y}$. It is easy to compute, and if the result is r equal to positive 1.00, we may safely say that the variables vary proportionately, with regard to their respective standard deviations and in the same direction. Just the opposite conclusion is drawn if r equals a negative 1.00. Theoretical statisticians, of whom Mr. H. C. Carver of the University of Michigan is an example, object to this measure on various grounds, one of them being that, when r is equal to plus or minus 0.50, there is not 50 per cent of positive or negative correlation, but rather about 25 per cent. Plus or minus 0.75 means about 50 per cent of sympathetic agreement, and plus or minus 0.85, about 75 per cent. With these cautions in mind, a truer picture of the significance of the measures herein may be gained.

The following table gives the crude birth-rates[1] and populations of the selected cities.

[1] Crude birth-rate figures, instead of the refined "fertility" rates, were used for the first series of fifty or more correlations out of which this paper grew. In the analysis subsequent to that presented here, intensive use will be made of fertility rates based upon the number of women of child-bearing age rather than upon a base of the total population.

TABLE I

City	Crude birth-rate per 1,000, 1920	Population, 1920
Detroit	27.17	993,678
Cleveland	23.96	796,841
Boston	26.00	748,060
Baltimore	25.04	733,826
Pittsburgh	24.98	588,343
Los Angeles	19.78	576,673
Buffalo	26.07	506,775
San Francisco	17.67	506,676
Milwaukee	22.84	457,147
Washington	19.91	437,571
Cincinnati	19.45	401,247
Minneapolis	23.87	380,582
Seattle	19.31	315,312
Indianapolis	21.53	314,194

One striking fact appears as these figures are read: the birth-rate tends to decrease as the size of the city decreases, and it does so with fair regularity. The correlation coefficient for these two variables is + .644.[2] It is suggestive, but we would be courageous to maintain that sheer populousness brings forth a high number of children per thousand residents. About the same thing may be said for the measure of agreement between the density of population per acre and the birth-rate, which produces an r equal to + .424.[3]

The statement chronically made by cursory students of this subject is that there is a high birth-rate among foreign-born persons

[2] To simplify the presentation of data, all detailed computations have been omitted. A summary of the correlations will be found appended to the text of this paper, along with a table of means, standard deviations and number of cases involved in each computation. The correlations are listed in the order of their appearance here.

[3] The problem of the probable errors of these correlation measures proved bothersome. It was decided to make up a table showing the size of the probable error at various "round" values of r, thus allowing interpolation for intermediate values.

In the following table the probable error is given for various values of r:

Value of r	Probable error
.00	.183
.20	.175
.40	.153
.60	.117
.80	.066
1.00	.000

within a town. Italian, Greek and other southern European stocks are believed to have large families; and all foreigners who have not as yet been Americanized are viewed similarly. Using the data of the Fourteenth Census to determine the total number of foreign-born whites for each city, and reducing this figure to a percentage of the whole population and correlating the result with the birth-rate, we find $r = +.369$. There appears to be some correspondence between the two series, but it amounts to no more than 10 or 15 per cent at best. But what about the other elements in the social structure which are reputed to be prolific child-bearers? For example, native-born whites with foreign-born parents should not be reduced to entire conformity with those whose ancestors arrived earlier; and native-born whites with mixed foreign and native parentage should have a few "large family traits" to contend against. What about negroes? What about those people whom the Census so quaintly calls "other persons"? An attempt was made to attack this problem. A summation was formed in this way: foreign-born whites were counted one; native-born whites with foreign parents, one for two; native-born whites with mixed foreign and native parents, one for four; negroes, one for one; and the same for "other persons." This was reduced to a percentage figure based upon the total population and correlated with the crude birth-rate: $r = +.455$. We have improved the correspondence, but it is not yet large enough to allow any strong arguments to be set up about the excessive child productivity of the "new-comers" to this country. Perhaps a stronger case could be made if the percentage of married persons, their ages and so forth, were carefully examined; but it does not seem clear from the data at hand that they are swamping us with their "inferior" offspring.

C. T. Brunner has presented an interesting analysis of reasons for the variations in urban birth-rates in England.[4] He (or she) states that in those cities where the birth-rate is highest, the age at time of marriage is relatively low, and that where the age at time of marriage is low, the number of women in the population is below normal; and he finishes his argument by inferring that

[4] Brunner, C. T., "Local Variation in the Birth Rates," *Economic Journal*, March, 1925, Vol. 35.

men must compete for women when they are scarce and marry them whenever they can be induced to say "yes"; but if women are comparatively plentiful, a man is able to pick and choose for a few years before committing himself. Thus the number of child-bearing years of the married couple is affected, and so the birth-rate. This may be the lead we are seeking in our investigation. If we take the ratio of men to women in the American cities and correlate it with the birth-rate, we discover r to be + .051. There is no apparent connection, then, between the scarcity of women in these American communities and the birth-rate. But what about the ratio of "marriageable women" to "marriageable men," if it is assumed that the "marriageable ages" are those between 15 and 40? When this ratio was tied to the birth-rate, the coefficient was −.204. Again, we are warned against the imputation of a causal nexus. This leads to the conclusion either that there is no competition for wives in these communities, which is pertinently affected by the sex percentage, or that the competition does not have a repercussion upon the intensity of child-bearing, or that such effects as there are will not make themselves felt in the crude birth-rates.

Another cause which should affect the birth-rate in an area is the percentage of married persons to the total population. Such a computation presents difficulties if the census data are to be used, because the numbers of married men and women within a city never correspond exactly. In every one of our communities the number of married men exceeded the number of married women. Presumably the answer is not polyandry, but rather the coming of husbands to the urban centers in search of employment. Probably there are also unattached married women in every place, but there is no way to determine the number. For a practical figure of the number of effectively married persons, the number of married women was multiplied by two. This product was then converted into a percentage of the total population figure and correlated with the birth-rate: $r = -.362$. Is this negative figure to be expected? The higher the birth-rate, the greater the number of persons per family, and, consequently, the lower the relative number of married persons. This leads to a second computation: persons under fifteen years of age were subtracted from the total

population, and then the number of effectively married was expressed as a percentage of this reduced figure. It is hoped that this new ratio (used hereafter) will in some measure eliminate the hiding of parents behind their offspring and give us a truer picture of the relation of the effectively married to the birth-rate. When the correlation is taken between these two variables, $r = +.241$. I feel that a further improvement in a positive direction could be achieved if we had considered only those effectively married women between the ages of fifteen and forty-five, but this would get us into the problem of "fertility" statistics, which is omitted in this paper. I believe it may be said, then, that a high relative number of effectively married does mean an increase in the birth-rate; but, for a time, we must leave this feature of our analysis.

Occupational conditions may yield useful clues, and we shall try to seek them out. The fourth volume of the Fourteenth Census concerns itself entirely with matters relating to the occupations of the American population. If we take the total number of gainfully employed persons in each community, and divide it by the total population, we find that the relative so gained shows a measure of $-.634$ when correlated with the birth-rate. This r is bolstered by three related coefficients: the percentage of men engaged to the total population ($-.378$); the percentage of women engaged to the total population ($-.374$); the percentage of women engaged to the total number of women ($-.423$). It seems that the greater the percentage of gainfully employed, the lower the birth-rate. Is it because the population has less time for children, or is it because there are relatively fewer effectively married people? The latter question may be in part answered affirmatively, for the r resulting from the comparison of the percentage of engaged persons to the total population with the percentage of effectively married persons amounts to $-.601$. This might be expected, in part, for where there are relatively few married couples, each of the potentially marriageable persons will experience greater pressure to work for a living. This argument, if true, partially stops us from saying that when there is less time for children, owing to a high percentage of working people, there will be fewer children; for we have shown that it is accounted for rather well by the low number of effectively married persons.

It has not been asked what sorts of work make up these gainfully employed percentages, so let us find the percentage of the population engaged in the various main census classifications and measure the agreement of each with the birth-rate. The results are tabulated below.

TABLE II

Correlation Coefficients of the Birth-Rate vs. the Percentage of the Population Engaged in Major Occupations

Percentage engaged in	Correlation
Manufacturing	+ .479
Transportation	− .312
Trade	− .528
Professional service	− .681
Domestic service	− .566
Clerical service	− .274

Each of these *r's* tends to be negative because the summation of the group of percentages gives a negative measure, and so the fact that the manufacturing *r* disagrees decidedly is highly significant. Apparently, cities with a manufacturing population in high proportion are cities with a high birth-rate. This is corroborated by the *r* of the percentage of the population who are manufacturing *wage-earners* as compared with the birth-rate, which equals +.391. Can we find a reason for this result?

The percentage of effectively married was shown to have an influence upon the birth-rate in a positive way, even though we admitted the figures of effectively married persons to be somewhat defective as showing the true percentage. Does this figure vary in a like direction with the percentage of people engaged in manufacturing? The *r* for this relation (percentage of effectively married vs. the percentage of population engaged in manufacturing) is +.564. (It will be recalled that the correlation between the percentage of the total population gainfully employed and the percentage of effectively married persons is −.601.) Account must also be taken of the −.533 correlation between the percentage of the population engaged in manufacture and the total percentage engaged in all occupations, despite the fact that the percentage of persons engaged in manufacturing bulks far larger than that of any other occupations with the exception of the conditions in non-

industrial Washington. What have we brought out to this point? The greater the intensity of manufacturing in a city as measured by the relative numbers employed in that service, the higher the birth-rate; the greater the intensity of manufacturing, the greater the number of effectively married people; the greater the intensity of manufacturing, the fewer persons, relatively, engaged in all classes of occupations. But before dealing further with these threads of our argument, let us seek a few more to weave with them.

Other possibilities are connected with the age of the population. It is not the usual thing for older married people to have children at the same rate as the younger. If we can find age differences in these urban communities, we shall have established another cause for variations in the birth-rate, and perhaps we can tie it up with manufacturing conditions. If the median age of the total population is computed — the median is used here rather than the arithmetic mean because of the ease of computation and the suitability of the data — and correlated with the crude birth-rate, an r of $-.845$ is discovered. This is about as perfect a correlation as can be expected from economic data, and it shows that the higher the median age, the lower the birth-rate. Yet have we not a somewhat self-generating factor? The more children, the lower the average age of the total population, and, therefore, a high negative correlation between the median age and the birth-rate would be expected. Let us eliminate the young people below fifteen years of age and find the median age of the remaining group, which would give us a rough approximation to the average age of the potential child-producing groups of the community. This new age figure, when correlated with the birth-rate, produces a measure of $-.626$, which is about as good a figure as is normally expected. Some will ask whether the median age of married people is not still more important in fixing the number of births per thousand. To answer this question, the r of the age of married women against the birth-rate shows $-.365$; the r of the men's ages, $-.531$. Again, it is found that the higher the age, the lower the birth-rate, but, strangely enough, men seemingly have more to do with the difference than women. I have been afraid to attempt an explanation of this last curious fact. Perhaps a still higher negative correlation would

appear if the median age of married men and married women were computed and correlated. Unfortunately, statistics of "age at time of marriage" were not available for this study. If they had been, we might have been able to add considerable pertinent analysis at this point.

In what sort of city, industrially considered, do the younger people live? If we correlate the median age of the population over fifteen years of age with the percentage of the population engaged in manufacture, we have $r = -.523$. Manufacturing towns, these manufacturing towns, are young people's towns. We know also that the percentage of effectively married persons is higher in the manufacturing cities, which is partially accounted for by the lower number of widowed, separated and divorced among younger folk. These two variables, the age of the population and the percentage of effectively married, must do a great deal toward affecting the birth-rate, and I believe we have shown that they do. There may be a great many other equally important causes affecting the rate, but the tempo of life and work in the industrial city seems to draw people who are young and vigorous in respect to child-bearing.

As an anti-climax, I should like to show one more cause working upon the age distribution and thus upon the birth-rate. Perhaps it also has a good deal to do with whether or not a city can be intensely manufacturing. The January-July temperature differences were taken as measuring the rigor of the cities' climate; slight differences showing mild climates, and large differences, more strenuous ones. These differences were correlated with the median age of the total population and an r of $-.778$ was found. The wider the range of temperature, the lower the median age, and the higher the birth-rate. Another climatic relationship showed an r of $+.692$ between the annual mean temperatures and the median age of the population. The warmer, mild towns are the towns of the older folk, and, according to Mr. Ellsworth Huntington, geographer, only a city of a low, varying temperature can be a great manufacturing center. At least these places are nearly all in the colder regions of the globe, though the development of our industrial South may disprove this theory.

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TABLE III

MEANS (M_x), STANDARD DEVIATIONS (σ) AND NUMBER OF ITEMS (n)

The Variables	M_x	σ	n
1. Crude birth-rate per 1,000	22.68	2.94	14
2. Population (000 omitted)	554.00	192.7	14
3. Persons per acre	17.88	6.51	14
4. Percentage of foreign-born whites in total population	20.52	8.42	14
5. Percentage of high birth-rate elements in total population	40.66	8.03	14
6. Ratio of men to women	$\frac{102.07}{100.00}$	8.69	14
7. Ratio of "marriageable women" to "marriageable men"	$\frac{100.00}{100.00}$	10.2	14
8. Percentage of effectively married in total population	41.88	2.52	14
9. Percentage of effectively married in population over 15 years of age	55.92	3.30	14
10. Percentage of population employed in all occupations	46.6	3.17	14
11. Percentage of men employed in total population	34.7	2.39	14
12. Percentage of women employed in total population	11.9	2.95	14
13. Percentage of women employed	24.0	5.04	14
14. See cross correlations, Table V			
15. Percentage of population employed in manufacturing	18.7	3.9	14
16. Percentage of population employed in transportation	4.2	.71	14
17. Percentage of population employed in trade	6.8	1.2	14
18. Percentage of population in professional service	3.1	.87	14
19. Percentage of population in domestic service	5.3	1.64	14
20. Percentage of population in clerical service	6.7	2.84	14
21. Percentage of population who are manufacturing wage earners	13.3	4.5	14
22. See cross correlations, Table V			
23. See cross correlations, Table V			
24. Median age of the total population	28.34	1.94	14
25. Median age of the population over 15 years of age	34 73	1.4	14
26. Median age of married women	36 2	1.24	14
27. Median age of married men	40.20	1.22	14
28. See cross correlations, Table V			
29. See cross correlations, Table V			
30. See cross correlations, Table V			
31. January-July temperature differences	40.44	13.71	14
32. Annual mean temperatures	51.7	4.47	14

TABLE IV

SUMMARY OF THE CORRELATION COEFFICIENTS OF THE BIRTH-RATE WITH CERTAIN VARIABLES

Correlated Variables	Resulting Coefficient
1. Birth-rate	.....
2. Population	+ .644
3. Number of persons per acre	+ .424
4. Percentage of foreign-born whites in total population	+ .369
5. Percentage of high birth-rate elements in total population	+ .455
6. Ratio of men to women	+ .051
7. Ratio of "marriageable women" to "marriageable men"	− .204
8. Percentage of effectively married in total population	− .362
9. Percentage of effectively married in total population over 15 years of age	+ .241
10. Percentage of population engaged in all occupations	− .634
11. Percentage of employed men in total population	− .378
12. Percentage of employed women in total population	− .374
13. Percentage of employed women in total number of women	− .423
14. See cross correlations, Table V	.....
15. Percentage of population employed in manufacturing	+ .479
16. Percentage of population employed in transportation	− .312
17. Percentage of population employed in trade	− .528
18. Percentage of population employed in professional service	− .681
19. Percentage of population employed in domestic service	− .566
20. Percentage of population employed in clerical service	− .274
21. Percentage of population who are manufacturing wage-earners	+ .391
22. See cross correlations, Table V	
23. See cross correlations, Table V	
24. Median age of the total population	− .845
25. Median age of the total population over 15 years of age	− .626
26. Median age of married women	− .365
27. Median age of married men	− .531
28. See cross correlations, Table V	
29. See cross correlations, Table V	
30. See cross correlations, Table V	
31. January-July temperature differences	+ .638
32. Annual mean temperatures	− .549

TABLE V

Summary of Cross Correlations, or the *r*'s for Non-Birth-Rate Series

The Variables	Resulting Coefficient
14. Percentage of employed persons in total population with percentage of effectively married persons in total population over 15 years of age	− .601
22. Percentage employed in manufacture in total population with percentage of effectively married persons in total population over 15 years of age	+ .564
23. Percentage of total population employed in manufacture with percentage of total population employed in all occupations	− .533
28. Median age of the population over 15 years with percentage of total population employed in manufacture	− .523
29. January-July temperature differences with median age of the total population	− .778
30. Annual mean temperatures with median age of the total population	+ .692

SOME ASPECTS OF PUBLIC OWNERSHIP OF ELECTRIC UTILITIES IN CANADA

HARALD S. PATTON

THE term "electric utilities," as applied to Canada, comes close to being synonymous with "hydro-electric utilities." Of the total energy generated in central electric stations, approximately 98 per cent is furnished by stations using hydraulic equipment. Canada, it is true, possesses roughly one quarter of the estimated coal reserves of the Western Hemisphere. In contrast, however, with the United States, whose high-grade coal deposits are for the most part located in areas of high population density and industrialization, Canada's coal fields lie either in the extreme east (Nova Scotia) or in the far west (Alberta and Vancouver Island), that is to say, in provinces which together embrace only 18 per cent of the population of the Dominion. In Ontario and Quebec, which contain 60 per cent of the total population and produce 80 per cent of the Dominion's output of manufactures, not a single ton of coal is mined. This "acute fuel area" has been abundantly compensated, however, in the magnitude and distribution of its water-power resources. In addition to their share of the hydraulic resources of the international waterway system of the Lake of the Woods, Great Lakes and St. Lawrence River, Ontario and Quebec possess in the interior waterfalls of the glaciated, pre-Cambrian Shield extending to their northern, Hudson Bay frontier, fully 60 per cent of the estimated available water-powers of the Dominion. In the United States the water-power situation is almost directly reversed. The industrialized regions of New England, the Middle Atlantic and North Central states, which use 65 per cent of all the power employed in American manufacturing, possess only 10 per cent of the water-powers of the country; whereas the Mountain

and Pacific states, which use only 8 per cent of the power employed in manufacturing, contain 72 per cent of the water-power resources.[1]

The development of the water-powers of Canada (in which the installed hydro-electric capacity today is two and one-fourth times as great as in 1920) has been actuated by a double purpose. On the one hand, water-powers have been harnessed as the cheapest means of supplying light and energy to the urbanized communities of the coalless provinces of Quebec, Ontario and Manitoba. On the other hand, many of the largest enterprises have been undertaken primarily to provide low cost power to the new pulp and paper, mining and electro-chemical industries which have arisen, particularly since the War, in the hitherto relatively empty Laurentian region between the Churchill River in northern Manitoba and the Saguenay Valley of lower Quebec. At the beginning of 1930 the total hydro-electric installations in the Dominion represented a capacity of 5,727,600 horse-power. This is equivalent to well over half a horse-power per capita, Canada being exceeded in this respect only by Norway. In the matter of electric consumption on a per capita basis Canada ranks first among the countries of the world. In 1928 the generation in central electric stations (steam and hydro-electric) in Canada was equivalent to nearly 1500 kilowatt hours per person, compared with less than 700 kilowatt hours in the United States.

EXTENT OF HYDRO-ELECTRIC PUBLIC OWNERSHIP IN CANADA

The public ownership movement in the Canadian electrical field has been associated primarily with the supply of electricity to general consumers in the more closely populated areas, rather than to large-scale but isolated users in the industries based on forest and mineral resources. The enormous hydro-electric consumption of the pulp and paper industry (which uses about 25 per cent of the total electric power generation in the Dominion) and of the mining, metallurgical and chemical industries of the Laurentian region is furnished almost entirely (with the exception of the Thunder Bay district served by the Ontario Hydro-Electric Com-

[1] See Voskuil, W. H., "The Water Power Situation in the United States," *Journal of Land and Public Utility Economics*, Jan., 1925.

mission) by privately owned power companies, many of which are subsidiaries of the consuming industries, as in the case of the International Paper Company, the Aluminum Company of Canada and the Hudson Bay Mining and Smelting Corporation.

In five of the provinces power commissions have been created to supply electricity to municipalities. The pioneer in this field, and the administrator of the largest publicly owned power system in the world, is the Ontario Hydro-Electric Power Commission, established in 1906. It distributes approximately 1,100,000 horsepower, most of which is derived from Niagara Falls, although twenty-two different water-power plants are operated by the Commission. In Manitoba public ownership is represented by the Winnipeg Hydro-Electric System and the Manitoba Power Commission. The former was authorized by municipal by-law in 1906 — the same year as that which witnessed the birth of the Ontario Hydro-Electric Commission. It competes with the privately owned Winnipeg Electric Company in supplying the Manitoba capital with electricity, generated at separate power sites on the Winnipeg River 70 to 80 miles to the east. Its present installed capacity of 102,000 horse-power is in process of being supplemented by a new development on the same river, with an eventual capacity of an additional 100,000 horse-power. In 1929 the Winnipeg Hydro delivered 450 million kilowatt hours to 74,500 customers. The Manitoba Power Commission was created in 1919, with a view to supplying other municipalities in the province through a public agency. While operating its own transmission system, the Manitoba Power Commission purchases its power from the Winnipeg Hydro. It supplies forty-three towns in southwestern Manitoba. In 1920 the provinces of Nova Scotia and New Brunswick both passed legislation creating electric power commissions. The water-power resources of the maritime provinces are not extensive (amounting to less than one per cent of the recorded powers of the Dominion) and developments have been on a relatively small scale. The Nova Scotia Power Commission operates seven small generating plants, the output of which is sold to privately owned distributing companies, the rates charged by the latter being regulated under the supply contracts. The New Brunswick Commission

delivers directly to some dozen municipalities the power which it generates or purchases.

In 1929 the prairie province of Saskatchewan, whose water powers lie mostly outside the settled agricultural area, and whose municipalities are supplied mainly by small local steam or internal combustion plants, passed legislation creating a provincial power commission, whose function is to survey the power resources and requirements of the province, and carry out a policy of public acquisition and interconnected supply. At the present time over two thirds of the electrical energy produced in the province comes from municipally owned plants.

Amending legislation passed during the last session of the Saskatchewan legislature embodies the following provisions:

(1) Refusal to grant private corporations the privilege of constructing high power transmission lines outside the limits of cities and towns in which their plants are located.

(2) Authorization to expropriate power plants owned by private corporations where the invoking of such authority is deemed necessary.

(3) Prevention of municipally owned plants from being transferred or leased to private corporations without consent of local government board.

In the province of Alberta, to which the federal government has recently transferred the control of its natural resources, the provincial legislature, by an almost unanimous resolution in April of this year (1930), approved the following declaration: "That in framing policies for the administration of the natural resources the principle of public ownership and control of power development should be fully safeguarded, so as to facilitate the government undertaking the whole or such part of power development as it may from time to time, with the advice of the technical experts, consider economically sound and expedient."

In the provinces of Quebec in the east and of Alberta and British Columbia in the west, which between them possess over half the water-power resources of the Dominion, the generation and distribution of electrical energy is, with the exception of a few municipal power plants, entirely in the hands of privately owned

corporations, grouped under powerful holding companies such as the Shawinigan Water and Power Company, Montreal Light, Heat and Power, Consolidated, the Canadian Hydro-Electric Company and the British Columbia Electric Company. In Quebec the supply of electricity to urban communities has been closely associated with the hydraulic generation of power for large-scale pulp and paper and electro-chemical industries, located near water-power sites in the St. Maurice and Saguenay valleys, whose surplus power is transmitted to Montreal, Quebec City and other St. Lawrence communities. In southern Ontario, on the other hand, Niagara Falls were harnessed primarily with a view to supplying general urban power and light demands. Hence the dominance of municipal interest in electric supply and distribution in that area. While Quebec has adhered to the policy of entrusting hydro-electric development and distribution to private corporations rather than to a provincial commission, she has, ever since 1910, maintained a governmental agency known as the Quebec Streams Commission. The functions of this body are to make surveys of water-power and reservoir sites, and, with the approval of the government, to undertake the construction and operation of regulating dams and storage reservoirs. While the financing of such works is undertaken by the government, power and pulp companies benefitting by the uniformity of stream flow thus assured are required to pay annual dues to the Commission on the basis of the amount of water used, at a rate calculated to cover all operating, maintenance and capital charges. This is in addition to annual rentals for power sites and royalties on energy actually developed as stipulated in conditional water-power leases. The latter have replaced the earlier policy of outright alienation, as embodied in the 1898 charter of the Shawinigan Water and Power Company which granted to that corporation absolute ownership of the strategic water-power site at Shawinigan Falls on the St. Maurice River.[2]

[2] See Patton, H. S., "Hydro-Electric Power Policies in Ontario and Quebec," *Journal of Land and Public Utility Economics*, Aug., 1927, pp. 225–228.

CHARACTERISTICS OF PUBLIC HYDRO-ELECTRIC SYSTEMS IN CANADA

From the foregoing brief survey of the hydro-electric situation in the Canadian provinces, it will be seen that public enterprise has assumed a considerable variety of forms. In Ontario the plan has been that of generation or wholesale purchase and transmission by a provincial commission, and of distribution through coöperative municipal systems. In Manitoba, on the other hand, it is a metropolitan city which has undertaken the work of generation and primary transmission, and which supplies power, not only to its own citizens in competition with a private utility, but also to a provincial commission for redistribution to other municipalities. In New Brunswick the provincial commission supplies power directly to municipalities; in Nova Scotia the commission generates power which its sells to private distributing companies. In Quebec the Streams Commission is limited to the construction and operation, or the engineering supervision, of stream control works. In Saskatchewan the recent legislation creating a provincial power commission contemplates a modified reproduction of the Ontario plan. In Alberta merely a legislative declaration of the policy of public ownership and operation has been registered.

Inasmuch as the Ontario Hydro-Electric system is by far the most extensive, and as its organization and methods have largely influenced the policies of the other provinces, it is the features and results of that system which will be chiefly taken into account in the accompanying observations concerning Canadian experience in public ownership and operation of hydro-electric utilities.

COÖPERATIVE STRUCTURE

Probably the most distinctive feature of the Ontario Hydro-Electric system is its coöperative character. The genesis of the movement is to be found, not in the platform of any political party nor in the initiative of the provincial government, but in the desire of certain municipalities to obtain electric energy from the great potential source at Niagara Falls, at lower cost than could be expected from any of the three private companies (the Canadian Niagara Power Company, the Ontario Power Company and the

Toronto and Niagara Power Company) to whom hydraulic franchises had been granted by the Niagara Falls Park Commission between 1900 and 1903.[3] To a coalless province like Ontario the disposition made of the hydro-electric potentialities of such a strategic natural monopoly as Niagara Falls was a matter of prime concern. Under pressure from interested municipalities the Ontario government enacted permissive legislation in 1903 whereby associations of municipalities might engage in coöperative distribution of power, after investigation and favorable report by a joint commission. Thereupon the City of Toronto and six other municipalities organized the Municipal Electric Commission, which undertook an extended investigation of the problem of making Niagara power available on the most advantageous terms for the future as well as for the immediate needs of Ontario municipalities. Out of the report and the popular resentment which at that time ran high against the arrogant attitude of certain utility interests, there evolved the Power Commission Act of 1906 which created the Ontario Hydro-Electric Power Commission with powers, not merely of fixing the rates which private utilities might charge for service, but also, with the consent of the government, of expropriating existing generating utilities in the event of non-compliance, and of supplying power directly to municipalities with which a contract had been approved by by-law. In contrast with the earlier measure which authorized municipalities to combine into power groups and operate through separate commissions, the legislation of 1906–7 created a single, provincially appointed power commission to act on behalf of all municipalities desiring to obtain power under such arrangements.

While the Ontario Hydro Commission (one of whose members must be a member of the cabinet without portfolio) is neither appointed by, nor is responsible to, the participating municipalities, it functions as their agent and trustee under terms of contracts, consistent with the act, which have in each case been approved by vote of the citizens of the municipalities concerned. As a matter of experience, organized representatives of the latter, through their Municipal Niagara Power Union, have exerted no small influence

[3] See Mavor, James, *Niagara in Politics*, pp. 27–33.

in the determination of Hydro policy, and in the shaping of various amendments to the Power Commission Act, which have been made from time to time.[4] The Ontario plan embodies the great advantage of providing a single, centralized public agency for power supply, with which all interested municipalities can enter into arrangements as local distributors under similar conditions. Furthermore, as will be shown more fully below, the coöperative character of the relationship is carried out in the financial arrangements between Commission and municipalities, whereby the earned surpluses of the former, and the equity in its assets, accrue to the participating municipalities in proportion to their respective patronage. In brief, the history of the Ontario Hydro system represents a case of joint power supply undertaken on the initiative of, and on behalf of, associations of municipal consumers, in contrast to the more familiar situation, whereby supply is controlled by generating companies which bargain with, and not infrequently dictate to, consumers concerning the terms of supply and service.

APPLICATION OF SUPERPOWER PRINCIPLE

The technical counterpart of the coöperative plan of the Ontario Hydro system is to be found in the application, from the very inception of the enterprise, of the superpower principle of large-scale, interconnected and coördinated supply, on which the economic justification of the current sweep of combination and holding company organization in the utility field is chiefly based. That this policy has been steadily pursued from the beginning in Ontario is due primarily to two factors — a physical and a personal one. In the first place, the desire of the municipalities of southwestern Ontario to avail themselves of Niagara Falls as a source of electric energy, in place of dependence on local steam plants using imported coal, necessarily involved a pooling of local demands and a centralization of supply. In the second place, the course of power development in Ontario was largely shaped by the bold vision and aggressive personality of Sir Adam Beck, chairman of the Commission from its inception in 1906 to his death in 1925, who bore

[4] The political activities of the "Hydro" Union are strongly criticized by the author of *Niagara in Politics*.

the not inappropriate sobriquets of "The Power Knight" and "Ontario's Apostle of Power."

In supplying and anticipating the municipal power requirements of Ontario, the Commission has drawn on supply sources of three different classes: (1) Its earlier efforts were concentrated on tapping the resources of the Niagara River as the greatest and most advantageously located single source of supply; (2) Later, in order to meet the needs of municipalities not situated within economic transmission range of Niagara, it undertook the development and, where justified, the interconnection of lesser water-power sites in other parts of the province, so that today it operates seven minor systems, in addition to the Niagara System, the most distant being the Thunder Bay System supplying the lake-head cities of Port Arthur and Fort William in New Ontario; (3) As these have not been sufficient to meet the voracious power appetite of the province, and as the utilization of the great potential resources of the upper St. Lawrence and lower Ottawa rivers is precluded pending the outcome of the protracted and complicated negotiations between the United States and Canada in the one case, and between Ontario, Quebec and the Dominion governments in the other, the Commission recently augmented its supply by purchase contract and interconnection with the Gatineau Power Company in Quebec (controlled by the International Paper Company). Arrangements have also been made to obtain additional power from the Beauharnois Power Company, which is at present constructing a 500,000 horse-power development on the Quebec section of the St. Lawrence.

In the utilization of Niagara power three different phases may be distinguished. In the first the Commission merely purchased power under wholesale contracts with private generating companies at Niagara Falls and delivered it over its own transmission lines to the contracting municipalities. The second phase was marked by the acquisition of the private generating plants at Niagara, first of the Ontario Power Company in 1916, and later in 1922 of the Toronto and Niagara Power Company, giving a combined capacity of 325,000 horse-power. The third phase, entered upon during the war, was that of direct development. This took the form of the construction of a twelve-mile power canal from above the Falls

to Queenston Heights (the original seat of the Falls), where a head of 298 feet was obtained, as compared with 135 and 180 feet, respectively, at the Falls themselves.[5] This permits the recovery of practically twice the amount of power for the same diversion of water. With the impending completion of the tenth generating unit at Queenston, a total capacity of over 600,000 horse-power will be attained at that site, the largest single development in operation in the world. Since the maximum diversion of Niagara water (36,000 cubic feet per second) allotted to Canada, in the right of Ontario, under the international agreement of 1910 has now been reached, part of the increasing power requirements of the Toronto area have been met by importing Gatineau River power from Quebec, the current being carried over a 222,000-volt transmission line 230 miles in length, which is now in process of being duplicated. A branch of this transmission line conveys Gatineau power to Hydro municipalities in eastern Ontario, interconnection being made with lines carrying current purchased from the Cedar Rapids Power Company on the upper St. Lawrence. For the fiscal year 1927–28 the Commission supplied electric energy to the extent of 324 million kilowatt-hours, of which 95.4 per cent was generated by its twenty-two different plants, and the remaining 4.6 per cent purchased from private companies.[6] Thus while eight different systems based on regional power sources are operated by the Commission, interconnection between these, where justified, and unified administration have converted the whole of Old Ontario lying between the Ottawa and St. Lawrence rivers and the Lower Lakes into one great superpower area, with a lesser power area at the head of the Lakes, based on Nipigon River water-power. In 1928 the Ontario Hydro Commission delivered power to 277 municipalities and 131 rural power districts, as well as supplying energy directly to a large number of industrial concerns.

In addition to its functions as a province-wide producer and wholesaler of electrical energy on a superpower basis, the Ontario

[5] See Patton, H. S., "Hydro-Electric Power Policies in Ontario and Quebec," *Journal of Land and Public Utility Economics*, May, 1917, pp. 139–140.

[6] *Twenty-first Annual Report, Ontario Hydro-Electric Power Commission*, p. 8.

Hydro Commission has from the outset performed the services associated with engineering and management subsidiaries of public utility holding companies. When municipalities desire to obtain power from the Commission, the latter's engineers prepare estimates of requirements and costs on which contracts are based. The Commission then arranges, on behalf of the municipalities, for the purchase, construction or extension of local distributing systems, and generally supervises their management and operation, especially in smaller municipalities. In the case of the Central Ontario system, which embraces a group of utilities formerly operated by twenty-two subsidiaries of the Electric Power Company, which was acquired by the province of Ontario in 1916, the Commission operates the local utilities directly as trustee for the province. It likewise administers directly the various rural power districts (of which more will be said below), as well as certain radial railways on behalf of the municipalities concerned. The Commission thus functions in both a technical advisory and supervisory capacity to municipal systems, and in a direct management capacity in relation to utilities which for various reasons are not adaptable to local administration. These services are rendered to the communities concerned, either without specific charge or on a strictly cost basis.

On a much more limited scale the provinces of Nova Scotia, New Brunswick, Manitoba and Saskatchewan are likewise proceeding along the lines of centralized and coördinated power supply under provincial agencies acting for municipalities. Thus public ownership of electric utilities in Canada is something much more comprehensive than independent municipal systems, which is the form that public ownership has generally assumed in this country, except where electrical generation has been incidental to the operation of federal navigation or irrigation dams. It is in the development of public ownership in terms of "superpower areas" instead of merely local supply and in the assumption of the technical and management functions otherwise performed by public utility holding companies, that the Canadian provinces have made one of their most distinctive contributions.

FINANCIAL ASPECTS

The extensive construction undertakings and the acquisition of privately owned utilities by the Ontario Hydro-Electric Commission, together with the distributing systems of the Hydro municipalities, represent a capital investment of impressive proportions in relation to the population concerned. For the fiscal year ending October 31, 1928, the capital invested in the Commission's various undertakings aggregated $211,217,481; that of the Hydro municipalities totaled $85,986,288.[7] The combined investment of nearly $300,000,000 is equivalent to approximately $100 per capita for the entire population of the province.

The financial basis of Ontario's hydro-electric system is unique in public utility experience. Four parties are involved. First, the Commission itself; as the agency of the provincial government, which appoints it, from which it derives its powers, and to which it renders account; as the trustee of the associated municipalities on whose behalf it generates and transmits power and, in some cases, operates radial railways; and as the principal in whom title to properties is vested and by whom contracts are assumed and primary financial responsibility borne. Second, the municipalities, as direct owners of their local distributing systems, and as joint sharers in the equity in the properties vested in the Commission, to which they are financially accountable. Third, the provincial government, as the constitutional source of the powers both of the Commission and of the municipalities, as the financier and guarantor of the Commission's undertakings, and as the supervisor of its acts. Fourth, private individuals or investment institutions which have provided the actual capital, as holders of bonds issued (1) by the provincial treasury on the Commission's account; (2) by the Commission and guaranteed by the province; (3) by acquired public utility companies and assumed by the Commission; (4) by Hydro municipalities.

In this involved public ownership structure, in which no common stock appears, the assignment of the "entrepreneurial" responsi-

[7] *Twenty-first Annual Report, Ontario Hydro-Electric Power Commission*, p. 7.

bility is not altogether apparent. Where the Commission has undertaken construction work of its own, such as its transmission lines and the Chippawa-Queenston and Nipigon developments, the funds have been advanced directly by the provincial treasurer from the proceeds of government bond issues. Where it has bought out privately owned power and radial companies, it has issued commission debentures, guaranteed by the province, and has assumed the outstanding bonds of the companies concerned, with the province as secondary guarantor.

The real liability for meeting the Commission's capital charges, however, falls upon the Hydro municipalities. Though the governing principle of the Ontario Hydro-Electric system is that power shall be supplied to municipalities "at cost," the contract rate includes, in addition to the direct cost of delivering power to the municipal transformer station, the following indirect items: (1) interest on the Commission's investment in the generating and transmission system concerned, pro-rated according to the municipality's relative use of such primary equipment; (2) yearly provisions for obsolescence and contingency reserves applicable to them; (3) pro-rated share of the Commission's administrative expenses; (4) annual sinking fund payment on basis of thirty-year debt extinction. Under the uniform accounting system administered by the Commission, provisions for corresponding items in respect to municipal electric utilities are included in the rates charged to municipal consumers. Thus, though the province is the legal guarantor of the Commission's capital obligations, the effective responsibility is carried by the associated municipalities, which, in turn, shift the burden to local consumers and taxpayers (in respect to street lighting). Thus far, the province has not been called upon to discharge its guaranty to Hydro security holders, nor has the Commission technically failed to meet its interest obligations to the treasury, although in certain cases, as in the Chippawa-Queenston development which involved a capital expenditure of $76,000,000, interest on construction advances in the early years was funded and the commencement of sinking fund payments was deferred for a five-year period.

Since the cost of power to the municipalities is adjusted to cover

all charges, the financial risk is effectively carried by the associated municipalities, and not by the provincial treasury. It is the municipalities, therefore, which may be regarded as the "joint entrepreneurs" in the Ontario Hydro system; and their equities in the enterprise are represented by sinking fund payments and surpluses standing to their credit.

There are three features of the Ontario Hydro financial system which call for special comment. These are to be found in (1) the absence of common stock in the financial structure; (2) the low cost of borrowing; and (3) amortization provisions.

(1) The fact that no outstanding common stock appears among the liabilities of the Hydro system has a twofold significance. It means, in the first place, that the capitalization represents actual cash investment in construction and acquisition, so that the basis of "valuation" is reduced to the single standard of "original cost." In the second place, all capital invested in the enterprise carries a fixed interest charge (except as retired through sinking fund reserves, or where municipalities have been able to finance extensions out of surplus). In respect to its capitalization two rather contradictory criticisms have been made against the Commission: one, that its capital costs have been excessive; and the other, that properties of private utilities have been acquired at valuations unfair to stockholders of the latter. In the first connection it has been pointed out that the cost estimates of Hydro engineers have been repeatedly and egregiously exceeded under actual construction, most conspicuously in the case of the Chippawa-Queenston development, of which the original cost estimate was between $10,000,000 and $15,000,000, and of which the completed cost of the power canal, apart from turbine installations, amounted to $55,000,000.[8] The excess cost was due mainly to two factors: the decision to enlarge the capacity of the undertaking beyond that

[8] The engineering and financial operations of the Commission in respect to the Niagara and Nipigon developments are subjected to detailed criticism in the report on *Government Owned and Controlled Compared with Privately Owned and Regulated Electric Utilities in Canada and the United States*, made by Murray and Flood for the National Electric Light Association, 1922. The criticisms in the Murray-Flood report were vigorously answered and many of the statements challenged in a *Refutation* published by the Commission in 1922.

originally contemplated, and the prosecution of construction work under the abnormal conditions of war-time costs. To have postponed completion would have involved continuing fixed charges without any additional power supply or revenue. In view of the acute power shortage of the period and of the subsequent rapid absorption of the entire available load on the enlarged basis, the construction policy of the Commission would seem to have been fully justified. The effective utilization of major water powers is an enterprise that cannot be undertaken piecemeal, as in the case of fuel plants, and in anticipating the future requirements of the province, in the face of heavy initial costs of the Niagara and Nipigon River enterprises, Sir Adam Beck, in the light of subsequent developments, appears to have displayed sounder economic judgment than that expressed by the authors of the Murray-Flood report made for the National Electric Light Association in 1922.[9]

The policy followed by the province of Ontario and the Power Commission in acquiring private utility properties has been severely criticized by the late Professor Mavor in his book, *Niagara in Politics*, in which it is claimed that inadequate allowance was made for stockholders' equities, and that acquisitions were made under threat of expropriation. The circumstances in the various cases cannot be discussed in this paper. It may be stated, however, that, except in a single minor case, the Commission has never exercised its powers of expropriation, although up to 1922 it had purchased twenty water-power concessions, thirty hydraulic generating plants, and over sixty electric distribution systems.[10] So far as the financial structure of the system is concerned, the result has been that overcapitalization has been prevented, and that the question of rate-base valuation — the most baffling of all problems in public regulation of privately owned utilities — has been put beyond controversy under the Ontario system, since the investment cost is a matter of actual and precise record.

(2) Though all capital employed in construction and purchase has to be borrowed by the Commission, the cost has been reduced

[9] See Patton, H. S., *op. cit.*, pp. 231–233.

[10] Ontario Hydro-Electric Power Commission, *Refutation re Murray-Flood Report*, p. 14.

to a minimum, since the rate of interest charged on treasury advances is the same as that which the government has to pay on its bonds, while the provincial guaranty of the Commission's own debentures permits the issue of these at prices and interest rates favorable to the borrower. Capital borrowing under this plan obviously involves very substantial savings in underwriting charges, and since the Commission does not issue bonds for construction purposes, it pays interest only on advances as made from time to time by the treasury, instead of being obligated to pay interest on bond flotations from date of issue. These savings are of course reflected in the rates charged to municipalities for power.

(3) The practice of including in the cost of power amortization charges on a thirty- to forty-five-year debt retirement basis is contrary to that generally allowed under public regulation of utilities in this country, where the usual procedure is to refund maturing bonds. The Ontario practice involves, it is true, the imposing of a heavier burden on present consumers for the benefit of future consumers. Sinking fund provisions account for about 10 per cent of the total charges made to municipalities for power. This has not prevented, however, the establishment of rates which, as will be shown below, are substantially lower than those which, under other systems, do not include such a cost item. The amount of these sinking fund payments is a measure of the equity of the municipalities in the assets of the Commission, and permits the possibility of progressive rate reduction as interest charges are reduced. At the end of the fiscal year 1927–28 the combined net equity of two hundred and fifty-six participating municipalities in the assets of the Commission amounted to $12,326,097; while the accumulated equities in local distributing systems (as represented by retired debentures, local sinking funds and operating surpluses) aggregated $26,544,670.[11] The combined equities of the Hydro municipalities at the date given were thus equivalent to about one eleventh of the total capital investment in the entire enterprise.

[11] *Twenty-first Annual Report, Ontario Hydro-Electric Power Commission*, p. 251.

SERVICE AT COST

The ultimate test of the effectiveness of public ownership of electric utilities is to be found in the comparable prices at which service is rendered. As explained above, the principle upon which the Ontario Hydro system has been established and operated is that of "service at cost." This involves two successive price-making processes: first, the determination of the charges made by the Commission for delivering power to municipal transformer stations; and, second, the fixing of rates to be charged to consumers by the municipalities for different classes of electrical service. The various items entering into the computation and pro-rating of power costs to municipalities have already been noted. In order to insure precision and elasticity in the application of the "supply-at-cost" principle, the Commission follows the practice of making an interim charge monthly, based upon the estimated cost, and, at the end of each year, making credit or debit adjustment in accordance with actual ascertained cost, each system being required to cover its own costs. During the war period and the years of heavy construction at Niagara the municipalities of the Niagara system were confronted with increased costs, but the general tendency has been downward as load factors have been built up and debt retired. The great merit of the plan is the prompt and automatic nature of adjustments, and the avoidance of the contentious and protracted rate hearings associated with public regulation of privately owned utilities.

Each municipality sells electrical energy to its own consumers at rates and under conditions approved by the Commission. These are calculated to cover, in addition to the cost of power as charged by the Commission, the local costs of distribution, including interest, renewal and contingency reserves, and sinking fund payments on the municipal investment. In many of the local systems the growth in consumption has been so rapid that, in spite of repeated reductions, surpluses are frequently accumulated. Since these cannot be returned to individual consumers, they have for the most part been reinvested in local extensions and improvements. In the case of energy supplied for municipal street lighting, street

railways and pumping, any excess of charges over costs, as determined by the Commission, is returned to the municipal corporation.[12]

From the commencement of its operations the Commission introduced in the municipalities served by it three-part rate schedules for the three main classes of service; namely, residential or domestic, commercial lighting and power services. The form of rate schedule for each class is designed to insure, as far as is practicable, that each consumer shall be charged with the actual cost of the service he receives. One of the results of this rate-making method has been that the differential between rates charged to domestic and industrial power consumers is much narrower than is generally the case where electricity is supplied by private companies. In an intensive study recently conducted, under the auspices of the School of Citizenship of Syracuse University, of costs and revenues of thirty-three municipalities of the Ontario Hydro system and of thirty-five private distributing companies in New York State, it was found that, though the retail revenue of the latter, per kilowatt hour sold for all classes of service, was 70 per cent higher than that collected by the Ontario municipalities, the revenue per kilowatt hour for domestic service and commercial light was nearly three times as great in New York, and for street lighting 170 per cent greater.[13] The low rate schedule for domestic service in Ontario is to no small extent a reflection of the fact that the provincial Hydro system was conceived and initiated in the interests of municipal consumers. It has frequently been charged indeed that domestic service, for political reasons, is furnished in Ontario below costs, and that the loss so incurred is made up by higher charges to users of industrial power.[14] As shown, however, by the New York study referred to, retail power revenues per kilowatt hour were 30 per cent higher in New York than in Ontario Hydro cities, although the cost of

[12] See *The Ontario Hydro-Electric Power Commission of Ontario: Its Origin, Administration and Achievements* (Toronto, 1928), p. 18.

[13] See Peck, H. W., "An Inductive Study of Publicly Owned and Operated versus Privately Owned but Regulated Electric Utilities," *American Economic Review, Supplement*, March, 1929, pp. 199-201. The complete text of the joint study has since been published by Mosher and associates under the title, *Electric Utilities: The Crisis in Public Control* (Harper's).

[14] See, for example, Murray and Flood report, as cited in note 8, Section II.

power production to the utilities themselves was only 16 per cent greater in the former state.[15] The exceptionally low rates for domestic service in Ontario have been established on the basis of the specific cost of that class of service. Domestic demand has evidenced a surprising degree of elasticity, low rates inducing greater consumption, through the use of the widening range of household electrical appliances; increasing sales bringing about decreasing unit supply costs; and these in turn permitting still further reductions in "follow-up" rates. This interrelationship is strikingly illustrated in the case of the Ottawa Hydro system. In 1914 when the net charge per kilowatt hour was 5 cents, the average domestic monthly consumption was 19 kilowatt hours and the average monthly bill 95 cents. In 1926, when the charge per kilowatt hour had been reduced to one cent, the average monthly consumption rose to 179 kilowatt hours and the average monthly bill amounted to only $1.75.[16] Thus, though elasticity of domestic demand represents the response to low price, it is the cause of still lower prices, without prejudice to industrial power consumers. There are about one hundred and forty Ontario Hydro municipalities where the annual average consumption per domestic consumer is in excess of 600 kilowatt hours; in seven cities the figure exceeds 2,000 kilowatt hours.

For the year 1927–28, 86.6 per cent of the total kilowatt hours sold for domestic service in all Hydro municipalities was supplied at an average inclusive cost to consumers of less than 2 cents per kilowatt hour.[17] The average cost of electricity to domestic consumers in the United States in 1926 was estimated by the *Electrical World* as amounting to 7.4 cents. One explanation frequently given for the lower electric rates in Ontario is the exemption of the public Hydro systems from taxation. This is not a wholly correct assumption. While municipal Hydro properties are indeed tax-exempt, those of the Commission are only partially so, taxes being paid in certain cases on land which it occupies and in connection with various properties it operates. It also pays water-power

[15] Peck, H. W., *op. cit.*, pp. 200–201. [16] *Ibid.*, p. 213.

[17] *Twenty-first Annual Report, Ontario Hydro-Electric Power Commission*, pp. 354–357.

rentals to the province, and its bonds are not exempt from income taxation. The fact remains, however, that the Hydro system enjoys an appreciable advantage in this respect, as compared with private utilities. In the New York study referred to, it was found that taxes represented 7 per cent of the cost of production per kilowatt hour in the thirty-five New York distributing companies. This item does not go far, however, in accounting for the 70 per cent greater revenue per kilowatt hour collected by the New York companies, especially when note is taken of the fact that sinking fund payments included in the charges of the Ontario municipalities, for which no corresponding item appears in the New York production costs, amounted to three times as much per kilowatt hour as did the taxes paid by the New York companies.[18]

It is true that the extent to which Hydro properties and earnings are tax-exempt in Ontario represents a bonus to electric consumers at the expense of general taxpayers. Inasmuch, however, as municipal electric consumers and municipal taxpayers are largely identical persons, the shifting of the burden is more nominal than real. Furthermore, though the municipality derives no tax revenue from the local Hydro system, its outlay for street lighting service, etc., is lessened on that very account.

RURAL ELECTRIC SERVICE

While the initiative in the coöperative development of electric supply in Ontario was taken by some of the larger manufacturing cities, the progressive extension of the Hydro system throughout the municipalities of the province was bound to lead sooner or later to consideration of the possibilities of making electric service available to rural communities as well. During the governmental administration of the United Farmers of Ontario (1919-22) the demand for such application of the public ownership principle found legislative expression in a Rural Hydro-Electric Distribution Act. Under this measure the Commission was authorized to enter into contracts with rural townships for the supply of electricity at subsidized rates to hamlets and farms within rural power districts comprising one or more townships. Where a minimum of three

[18] Peck, H. W., *op. cit.*, pp. 204–205.

farm contracts per mile of rural primary pole line is assured, provincial grants-in-aid are available (under the amended act of 1924) to the extent of 50 per cent of the capital cost of the installation of rural transmission lines and equipment necessary to deliver power from the municipal distribution center to the boundary of the rural consumer's property.[19]

Under these conditions the extension of rural electric service has been impressive. At the beginning of the 1928–29 fiscal year, the Commission was operating 131 rural power districts comprising 233 different townships and serving some 13,000 farm customers, as well as 18,000 consumers in hamlets. In the construction of the 4,103 miles of rural primary transmission lines approved up to October 31, 1928, the provincial government grants-in-aid represented a capital contribution amounting to $4,464,709.[20] Last year over 2,000 miles of new rural power lines were erected. While rural electrification is thus being rapidly extended throughout the province, the actual load distributed represents a relatively insignificant proportion of the total energy supplied by the Commission, the peak load up to October 31, 1928, being equivalent to only 1.6 per cent of the total load for the month.

The necessarily high fixed costs per rural connection, where the number of possible farm services per transmission mile is generally under half a dozen, and the irregular nature of farm power demand, with resultant low load factor, are conditions which, under ordinary circumstances, cause the cost of electric service to be prohibitive to most farmers. In Ontario the system of government subsidization of the cost of rural pole-line construction, in combination with the extensive transmission network already constructed to serve the municipalities of the province, pooling of farm and hamlet loads, and the unified administration of all the rural power districts under standardized methods of line construction and operation, have made it possible for the Commission to supply electricity to farms at rates which in many cases are below those charged

[19] *The Ontario Hydro-Electric Power Commission: Its Origin, Administration and Achievements*, p. 23.

[20] *Twenty-first Annual Report, Ontario Hydro-Electric Power Commission*, p. 62.

to urban consumers elsewhere. In accordance with the established principle of service at cost, the rates charged to rural consumers, as in the case of urban service, are made up of two parts: a classified service charge based upon the individual connected load or demand, and a consumption charge based upon the cost of power at the point of delivery. In well-established districts the service charge, as additional consumers are connected, is reduced to 10, 15, 20 or more per cent below the standard initial rate. Thus for the class known as "light farm service," which includes the lighting of farm buildings, power for miscellaneous small equipment, power for single-phase motors not exceeding three horse-power demand, etc., the net cost to farm consumers, inclusive of all charges, is as follows:[21]

	Cost per kilowatt hour	
Annual consumption kilowatt hours	At standard initial rate	At 20 per cent less than standard
500	14.3 cents	10.6 cents
1000	8.1 "	6.2 "
1500	6.0 "	4.7 "
2000	4.9 "	4.0 "
4000	3.4 "	2.9 "

In subsidizing rural power distribution the province of Ontario has committed itself to applying general revenue for the benefit of a particular class of the community, proposals to provide for the subvention through taxation of provincial Hydro properties having been rejected, owing to the opposition of the Hydro municipalities. This course has been justified as being in accord with the established policy of promoting the basic industry of agriculture and as providing one of the most effective means of ameliorating the conditions of farm life and labor, and of checking the tendency toward rural depopulation. Rural power lines, indeed, have come to be regarded in much the same light as rural highways, and in the extension of both, it may be observed, the profits of the government liquor monopoly have found two of their most productive applications.

[21] *The Ontario Hydro-Electric Power Commission: Its Origin, Administration and Achievements*, pp. 25–26.

CONCLUSION

In this paper comment has been confined to certain distinctive and constructive features of public ownership and operation of electric utilities in Ontario, as representing the most comprehensive and most fully matured system evolved in the Canadian provinces, of which six have undertaken or committed themselves to some form of public ownership. It is the experience of Ontario, indeed, which has largely influenced the trend of power policies in the maritime and prairie provinces, and which has been specially studied in relation to the water-power issue in the bordering state of New York. The outstanding feature of the Ontario system is to be found in the unique relationship developed between the Hydro Commission and the coöperating municipalities and rural power districts on the one hand, and the provincial government on the other hand. As has been shown, most of the economic advantages claimed for public utility holding company organization, such as superpower generation and interconnection, uniform service, and centralized management, purchasing and accounting for distributing units, have been realized, and in many cases anticipated, through the functioning of the Ontario Hydro Commission. At the same time, through the system of public financing and the application of the service-at-cost principle as evolved in Ontario, the problem of equitable rate-making has been immensely simplified, since it is not complicated by the difficulty of determining a reasonable rate base, under devious financial set-ups and conflicting valuation doctrines and court interpretations. Furthermore, as costs of electric supply are lowered through rationalized management, technical improvements and rising load factors, the savings under the Ontario plan are automatically and promptly transmitted to consumers, without involving the procedure of protracted and contentious rate hearings before public utility commissions.

In the history of Ontario's experiment in public ownership of power supply there have been times, it is true, when the Hydro Commission and the associated municipalities, under the aggressive leadership of the late Sir Adam Beck, showed a disposition to override constitutional and legislative limitations and to commit the

province to undertakings and policies not always wisely conceived, as in the case of the Hydro radial scheme. Two different commissions were appointed indeed by successive governments to investigate certain of the Hydro's operations and programs. Furthermore, the conditions under which certain privately owned utilities were acquired, tax exemption and the bonusing of rural electrical distribution have occasioned considerable controversy in the province. On the whole, however, sound, constructive policies have prevailed and the effective answer to criticisms is to be found in the level of its service rates, in the increasing range and density of electric consumption in the Hydro area, and in the mounting proportions of the municipal equities in the system. In the present crisis of power control, the experience of Ontario and of the other Canadian provinces following its leadership in the field of public ownership and operation, as an alternative to public regulation of privately owned utility groups, is deserving of careful and dispassionate study.

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A PRELIMINARY STUDY OF *COLEOSPORIUM SOLIDAGINIS* (SCHW.) THÜM. IN FOREST PLANTATIONS IN THE REGION OF THE LAKE STATES *

DOW V. BAXTER

COMPARATIVE freedom from fungous pests has been one of the qualities which has made *Pinus resinosa* a favorite tree for forest planting in Michigan. Red pine occupies 68 per cent of the 51,105 acres of planted area on the Michigan state forests alone (9), and approximately 31,000 acres [1] have been planted to this pine by the Federal Government on the national forests of this state. The greatest losses in red pine plantations in Michigan have been due largely to drought, frost and ice injuries.

In 1929 an infection of rust on the needles of red and western yellow pine in the forest plantations in the Saginaw Forest attracted attention. It was identified as *Coleosporium solidaginis* (Schw.) Thüm. and the identification was verified by Dr. G. G. Hedgcock. This is the rust which has been observed so frequently in its aecial stage on red pine and which is known in this stage as *Peridermium acicolum* Underwood and Earle.

This rust has been seen on red pine by a number of collectors in both the East and the Middle West and by the writer on this planted pine in several states. In the Middle West, Pierce (6) was the first to report it on red pine. He observed it in an open stand of young red pine (from two to eight feet in height) in Itasca Park, Minnesota. He reports that some of the small trees, under three feet in height, were nearly covered with it. He states that, "while the rust had the effect of stunting the trees, on the other hand, no

* Contribution No. 15 from the School of Forestry and Conservation, University of Michigan.

[1] Information kindly furnished by Forest Supervisor R. G. Schreck, U. S. Forest Service, Huron National Forest.

noticeable injurious effect was seen on trees six to eight feet in height. On the larger trees the rust was much less abundant than on the smaller trees." Rust was reported on the red pines in the woods, but the trees in the woods were not so badly affected, nor was there such a large percentage of the trees in the woods affected as of those in the opening.

Since there were several different stands of red pine on the Saginaw Forest, where the rust was observed by the writer, an opportunity was presented for making a survey study of it in stands of different ages which were grown on both similar and different sites.

AMOUNT OF INFECTION IN SIX-YEAR-OLD PLANTATION — TREES WITH SIMILAR STOCKING ON SAME SITE

A very severe rust infection was found on the red pine planted as 3–1 stock in the spring of 1923. Out of the total of 1,010 trees inspected only one red pine was found to be free from rust (Pl. XXVI). Three hundred and five trees were so severely [2] infected that the leaves on the lower branches of many of them died. The lower branches on a few other trees died.

The number of whorls infected, either slightly or severely, were those which were near the ground, as shown by Table I.

TABLE I

NUMBER OF INFECTED AND SEVERELY INFECTED WHORLS ON 1,010 RED PINE TREES MAY 25, 1929

(Average height of trees in plantation, 3.85 feet)

Whorls	Infected	Severely infected
First	691	296
Second	763	169
Third	644	33
Fourth	206	3
Fifth	17	0

[2] "Severely infected" means that one third to one half or more of the needles were infected on the branch or stem; at least most of the needles on the branch were red with rust.

AMOUNT OF INFECTION IN EIGHT-YEAR-OLD PLANTATION — TREES WITH SIMILAR STOCKING ON TWO DIFFERENT SITES

Very few, if any, studies which are concerned with the relation of needle rust infection to site have been made. For stem rusts Posey and Ford (7) report that the percentage of white pine infected with the white pine blister rust at Kittery Point, Maine, was lowest among trees of the smallest size and highest among trees of the largest size. For the area studied they report that the percentages of trees infected are correlative to their diameter size classes. In different units of this area they also found that the percentages of infected trees varied according to the degrees of pine stocking. They record that "the percentages of infected trees were highest in understocked stands and lowest in overstocked stands." Snell (10), on the other hand, states: "This general fact seems to hold true under certain conditions, especially where the infection is not heavy, but it is true in a very few cases where there is sufficient infection of pine to provide a fair test. . . . For example, at Kelm Mountain, with 97 per cent infection on the two acres, there was no difference in infection percentage whether the stocking was three thousand to the acre or only four hundred." This author says that the density of the stand apparently has no effect upon the degree of infection in his experimental plots.

A detailed survey of the amount of infection was made in an eight-year-old stand of rusted red pine trees which were growing on two different sites in the same plantation on the Saginaw Forest. The red pine was planted on these two different sites as 2–2 stock in the spring of 1921. A portion of this plantation bordered on an area planted with locust, which is designated for convenience as Site 1. The pine nearest to these locust trees were larger and evidently had been stimulated to a greater crown development similar to that already reported by Young (12) for box elder growing near locust on this same forest (Pl. XXVII). The red pine which grew near the locust were uniformly taller than those growing twenty-five feet away and the interlacing of the branches was pronounced. There was little or no interlacing of the branches in

those trees which grew some distance away from the locust on this second site. This second area may be designated as Site 2. The difference in size of crown in the same plantation of those trees which were planted near and those planted some distance away from the black locust plantation presented an opportunity to study the effect of site upon the degree of rust infection in a similarly stocked and similarly aged stand.

The heights of the trees on this area were measured and the severity of infection was recorded in the field by means of crosses. Each whorl was numbered, No. 1 being assigned to the whorl at the base of the crown. If one third or more of the needles were infected, two crosses (× ×) were recorded on the field sheet. One cross (×) was recorded for the whorls possessing needles with fewer infections. The data were recorded separately for each whorl and for each tree. The records were also kept separately for each row of red pine. The data which were collected for the row nearest the locust and for those rows away from the locust are recorded in Table II.

As in the six-year-old plantation, most of the rust infection was found on the lower branches of the pine in this stand, that is, "infection" and "severe infection" were found on the lower whorls of 870 trees out of 950 red pine observed. There was little difference in the number of first and second whorls infested. A marked difference was found in the amount of rust occurring on the first and third whorls and there was even less infection on the higher branches. The records also point out a greater *severity* of infection on the lower whorls.

There was no correlation obtained between the total number of whorls infected and the size of the trees, and it appeared that there was no apparent "screening" caused by the interlacing of the branches in the larger trees. The figures in Tables III and IV show that in 849 inside-stand trees of the plantation there was a greater percentage of the first, second, third, fourth, fifth, sixth and seventh whorls infected than on 101 of the "outside" pine of the stand. There was found also a greater severity of infection on the "inside" trees, as shown by this same table. Although even a casual observation indicated that the pine growing away

TABLE II

NUMBER OF TREES, AVERAGE HEIGHTS, NUMBER AND PERCENTAGE OF SEVERELY INFECTED RED PINE TREES NEAR LOCUST AND AWAY FROM LOCUST.

Sites arbitrarily based upon tree heights, Rows 1–10; Site 2, Rows 11–36. Row 1 is nearest to the locust; the distance increases with each higher number.

Row number	Number of trees	Average height	Severely infected	
			Number of trees	Percentage
1	6	10.9	0	0.0
2	6	14.0	0	0.0
3	6	13.2	0	0.0
4	8	11.2	0	0.0
5	7	16.4	0	0.0
6	9	13.6	0	0.0
7	9	13.8	0	0.0
8	27	11.9	0	0.0
9	34	12.1	0	0.0
10	32	11.5	1	3.1
11	33	8.3	2	6.0
12	32	7.1	16	50.0
13	27	8.2	12	44.5
14	27	9.2	11	40.7
15	27	7.1	10	37.0
16	25	8.3	5	20.0
17	22	8.1	1	4.5
18	26	8.8	4	15.4
19	26	9.4	10	38.5
20	30	10.0	12	40.0
21	34	8.6	23	67.6
22	32	9.2	4	12.5
23	32	9.3	1	3.1
24	34	7.6	0	0.0
25	28	8.8	2	7.1
26	27	9.2	7	25.9
27	29	9.3	7	24.1
28	30	9.5	1	3.3
29	31	8.5	1	3.2
30	30	8.5	4	13.3
31	30	9.1	10	33.3
32	34	8.8	19	56.0
33	34	9.3	25	73.5
34	34	9.0	4	11.7
35	34	8.4	6	17.6
36	30	8.4	5	16.6

from the locust were more *severely* infected, infection occurred on a majority of the trees growing near the locust. The infection was found as high as the sixth whorl on some trees in the first nine rows near the locust. The average heights (size) of the trees which grew near to and at some distance from the black locust trees are given in Table II. It can be seen from this same table, however, that the rust was much more severe on the smaller trees. The alternate host, *Solidago sp.*, was likewise much more prevalent here, where the light reached the forest floor (Table V). As the branches of the larger trees had interlaced and had shaded the ground, the alternate host for the rust was obviously more or less crowded out in the portion of the stand near the locust (Pls. XXVIII–XXIX).

Thirty-five quadrats were established in the plantation among the trees which grew near the locust, and a similar number were likewise measured off in the rows of the trees located some distance from the locust. These meter-square plots were located at equidistance apart (ten feet) on both sides. The relative abundance of the alternate host on the two sides was determined by making counts of the Solidago plots on each area. The figures obtained from the sample plots located away from the locust were averaged

TABLE III

Total Number of Inside-Stand Trees (849) Infected with *Coleosporium solidaginis*

Trees severely infected are counted as "infected"

Row number	Whorls infected	
	Number	Percentage
1	786	92.5
2	783	92.3
3	785	92.5
4	616	72.6
5	369	43.5
6	121	14.25
7	14	1.65

TABLE IV

Total Number of Outside-Stand Trees (101) Infected with *Coleosporium solidaginis*

Trees severely infected are counted as "infected"

Row number	Whorls infected	
	Number	Percentage
1	84	83.1
2	89	88.0
3	86	85.1
4	55	54.5
5	25	24.8
6	9	8.9
7	1	0.99

TABLE V

The Occurrence of Solidago in the Red Pine Plantation, Saginaw Forest, September, 1929

Number of plots	Average number of plants per plot under trees 1–14 feet from locust	Number of plots	Average number of plants per plot under trees growing 50 feet away from locust
24	14.4	24	33.2

and compared with the average figures obtained from the average number of plants found under the trees growing near the locust. These average figures (Table III) are considered representative of the occurrence of the alternate host in both areas of the same plantation.

The abundant occurrence of species of Aster, a genus reported as an alternate host for *Coleosporium solidaginis*, corresponds in general to that of *Solidago spp.* on the areas near the locust and away from the locust in this red pine stand. No rust infections

could be found on aster in this stand. These field observations correspond, therefore, to the findings obtained by Hedgcock and Hunt (5) in their inoculation work. The results obtained by these investigators indicate that in the eastern United States *Coleosporium solidaginis* is a rust which attacks species of Solidago, but not those of Aster. As a result of their inoculations, which comprised 132 species of Aster and 241 of Solidago, they suggest that "in the eastern United States we either have two races of *Coleosporium solidaginis*, the one on species of Solidago, the other on species of Aster, or we have a second species of Coleosporium attacking species of Aster." These investigators have been able successfully to infect several different important pines with the telial stage of the Solidago form. *Pinus scopulorum* (*Pinus ponderosa* var. *scopulorum* Engelm.), the western yellow pine of the Rocky Mountains, was listed among the pines successfully infected with the Solidago form. These inoculations are of particular interest in view of the fact that severe natural infection was found on young western yellow pine planted on the Saginaw Forest in southeastern Michigan.

Coleosporium solidaginis IN YOUNG WESTERN YELLOW PINE PLANTATIONS

Three different western yellow pine plantations were included in the survey made on the Saginaw Forest. In one plantation, Block 3, lot 3, the trees were planted in the spring of 1927 as 2–2 stock in mixture with Japanese red pine and Scotch pine. The trees of all species were exposed to the thousands of neighboring rust-infected Solidago plants on the area. Many of the western yellow pine were so severely infected that numerous leaves actually browned because the needles had been killed by the rust (Pl. XXX). No infection was found in the Japanese red pine or in the Scotch pine. The data secured relative to the amount of infection on this area are presented in Table VI.

Unfortunately no rust-free western yellow pine plantation of this same-age stock was available for comparison of the average growth of such a stand with those located in this plantation. Since the individual trees were not tagged at the time of the rust survey,

TABLE VI

RUST INFECTIONS IN MIXED WESTERN YELLOW PINE, JAPANESE PINE AND SCOTCH PINE PLANTATION, SAGINAW FOREST, MAY 25, 1929

Species	No.	No. infected	No. severely infected	Percentage infected and severely infected	Average height, May, 1928, in feet	Average height, Nov., 1929, in feet	Difference in heights
Japanese red pine...	307	0	0	0	3.14	3.4	0.26
Scotch pine.....	550	0	0	0	1.84	2.5	0.66
Western yellow pine	164	106	22	78	1.80	1.8	0.00

no comparison can now be given which might throw light on the reduction of growth of the individual trees caused by rust. No growth figures are available for comparison with the few rust-free western yellow pine in this stand. It happened that no height growth was made by this western yellow pine stand (see Table VI), although leaders two feet in length were common in older western yellow pine stands on this same forest. Both the Scotch and Japanese red pine exhibited height growth during this period.

Coleosporium solidaginis IN OLDER WESTERN YELLOW PINE PLANTATIONS

One thousand two hundred and thirty-nine western yellow pine trees, which were planted as two-year-old seedlings in the spring of 1909, and, in another stand, one thousand three hundred western yellow pine planted as two-year-old seedlings in the spring of 1912, were also inspected for rust. *There was no rust infection in these older western yellow pine plantations.* That the alternate host for the rust was present on this area was indicated by the counts which were made on thirty-two one-meter quadrats. An average of 9.3 plants per quadrat was obtained. The abundant occurrence of golden-rods and asters beneath this stand is illustrated in Plate XXXI.

This plate also shows the dead condition of the lower three or four whorls of branches of this western yellow pine stand and illustrates the natural pruning that has already been initiated. Drier conditions of the needles on these higher branches may account for the lack of infection in such older pine. Although these two plantations are only twenty-four and twelve chains away from the badly infected younger stand of western yellow pine and although the alternate host appears on the area, no infection occurred. In fact, one of these rust-free western yellow pine plantations actually bordered a rust-infected red pine planting.

Although *Pinus ponderosa* has been designated as a natural host (8), Weir (11) states: "On Pinaceae O, I. *Pinus contorta* Dougl., Washington, Oregon, Idaho, and Montana (type), not on *Pinus ponderosa* var. *scopulorum* as reported." The type material is reported on western yellow pine, but Hedgcock (4) and Rydberg find also that the host species is *Pinus contorta.* Hedgcock states further (4) that this renders doubtful the presence of the fungus on western yellow pine, since no other occurrence on this species has been reported. Several collecting trips have been made in all the western states, but the writer has never found this rust on western yellow pine, even when its uredinial stage was present in many localities visited. References to the occurrence of aecia on *Pinus contorta* are, however, numerous (1, 2, 3, 4, 5, 11). The natural infections of young rather than old western yellow pine in the eastern part of the United States are, therefore, considered a significant record.

DAMAGE CAUSED BY *Coleosporium solidaginis* IN PINE PLANTATIONS

It is evident from these studies that *Coleosporium solidaginis,* at least this strain, may attack young plantations severely and even endanger their survival. After a stand has formed a closed canopy, or after the lower branches of an individual tree are shaded out, no damage is produced by the rust. In all probability there is insufficient moisture present on the needles of these green branches for spore germination in such older stands. It is also possible that the older needles of western yellow pine are not so susceptible to

rust infection as the younger ones which appear even higher up in the crown.

No red pine have been killed by the rust, but it is believed that the rate of growth in young pine is greatly retarded. In older trees, or in stands which have closed over so as to exclude a large number of the alternate host plants, rust infection occurs, but no appreciable damage has been observed. Stands with different stocking were not available for comparison, but in those similarly stocked the severity of infection varied from site to site on the Saginaw Forest. This suggests that the influence of different degrees of stocking might be completely offset, or they may be emphasized by differences in site. It is equally possible that the influence of site might be affected by different spacings and that rust damage might consequently be mitigated by the character of stocking on different sites.

Figures which show the actual damage caused by such a needle rust as *Coleosporium solidaginis* are not available. In an attempt to estimate the damage that may result from the attacks of such needle-inhabiting fungi sixty-two red pine trees (including controls) in a six-year-old planting were variously stripped of their foliage. Some of the trees were completely stripped; in some the needles were taken from only the lower whorls; in others the upper branches were stripped; and in still others half of the needles were taken from all parts of the tree. As the results of this work will be the subject of a later report and as but one season's growth has been measured, it is sufficient to state only a few facts which might pertain to the occurrence of the rust. These preliminary studies show that, according to measurements made on eight trees during the 1929 growing season on the Saginaw Forest, no height growth took place, and that in trees stripped of the needles of the four basal whorls there was no height growth in eight trees as compared with the average height growth of 1.2 feet in fourteen controls. This one set of measurements is mentioned because the rust infection was found most frequently on the lower whorls. Although the rust did not cause the death of as many needles as there were on four whorls of branches, the figure does call attention to the large reduction in growth that there must be in a large

plantation area, even though there is a loss of a much smaller number of needles.

CONCLUSIONS AND SUMMARY

Red pine has been a favorite species for forest planting in the Lake States, partly because of its comparative freedom from insect and fungous attack. Among the fungi, *Coleosporium solidaginis* is the most common one which attacks *Pinus resinosa* in this region. Although no red pine trees have been killed by this fungus on the Saginaw Forest, the rust may cause severe damage in young stands by retarding height development.

On the young trees the needles on the lower branches were more severely infected than those on the upper whorls. In one stand there were, for example, 691 first whorls infected and 296 severely infected as compared with 206 infected fourth whorls and three severely infected. Infection on the older trees was found also to be more severe on the lower whorls in other stands, but there were no noticeably injurious effects from the infections on such older trees.

Infection occurred in a similarly stocked and similarly aged red pine stand in different degrees of severity on different sites. Although infected, there were no trees near the locust (Site 1) which were severely attacked. The greatest amount of infection occurred on trees growing some distance away from the locust (Site 2). Among this last group there was a great variation in the percentage of trees which were severely infected. In trees of this size (stand not completely closed) differences in amount of infection on outside and inside trees were slight; but there was as much, or even slightly more, infection found on those trees which grew on the inside of the stand. In addition to age of trees, it is suggested that differences in site may completely offset or emphasize differences due to stocking.

There were 14.4 alternate host plants per quadrat under the red pine on Site 1, and 33.2 Solidago plants per sample quadrat on Site 2.

Japanese red pine and Scotch pine were not infected, but young western yellow pine was severely attacked by the rust in the same

stand. This western yellow pine infection is of particular interest since the rust, although originally described on this species, has not been reported on this pine by later investigators. It has been pointed out in the literature that the aecial material on which the description is based was actually on lodgepole and not on western yellow pine. Artificial infections on this pine, however, have been secured.

Species of the genus Aster are reported to be an alternate host for *Coleosporium solidaginis*, but they were not infected on the Saginaw Forest. This western pine has been successfully infected with the so-called eastern rust. It has been suggested that in the eastern United States the rust attacks Solidago, but not species of Aster.

Although this Coleosporium under observation attacks young western yellow pine — apparently a new natural host — no rust infection occurred in older stands on the Saginaw Forest. In all probability a rust infection from *Coleosporium solidaginis* does little or no damage to western yellow pine after the trees have started to shed the lower needles. This probably accounts for the fact that this rust has not been found on older trees either in the plantations on the Saginaw Forest or in western yellow pine in the Rocky Mountain region and elsewhere.

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PLATE XXVI

Young red pine severely infected with *Coleosporium solidaginis* (Schw.) Thüm. Note aecia on lower branches and the presence of the alternate host in the vicinity of the young tree. Saginaw Forest, University of Michigan

Red pine. Trees on the left are near the locust. All trees on Site I in the plantation are of this size. The smaller trees on the right are growing at a greater distance from the locust. There are relatively few Solidago plants in the ground-cover under the taller trees. The Solidago plants have not been greatly reduced in number on Site II. Saginaw Forest, University of Michigan

PLATE XXVIII

Stand of red pine, same plantation, but growing at some distance from locusts. Note the abundance of the alternate host for the rust. Tree branches not interlaced. Saginaw Forest, University of Michigan

PLATE XXIX

Red pine growing near locust. Note the interlacing of the branches and the relatively few alternate host plants present on the area. Saginaw Forest, University of Michigan

PLATE XXX

Western yellow pine badly infected with *Coleosporium solidaginis*. Note alternate host leaves surrounding pine needles. Saginaw Forest, University of Michigan

PLATE XXXI

Old stand western yellow pine entirely free from rust. Note the abundance of the alternate host of the rust. Saginaw Forest, University of Michigan

THE FUNGI AND THE DECAY OF THE AMERICAN CHESTNUT: PART I

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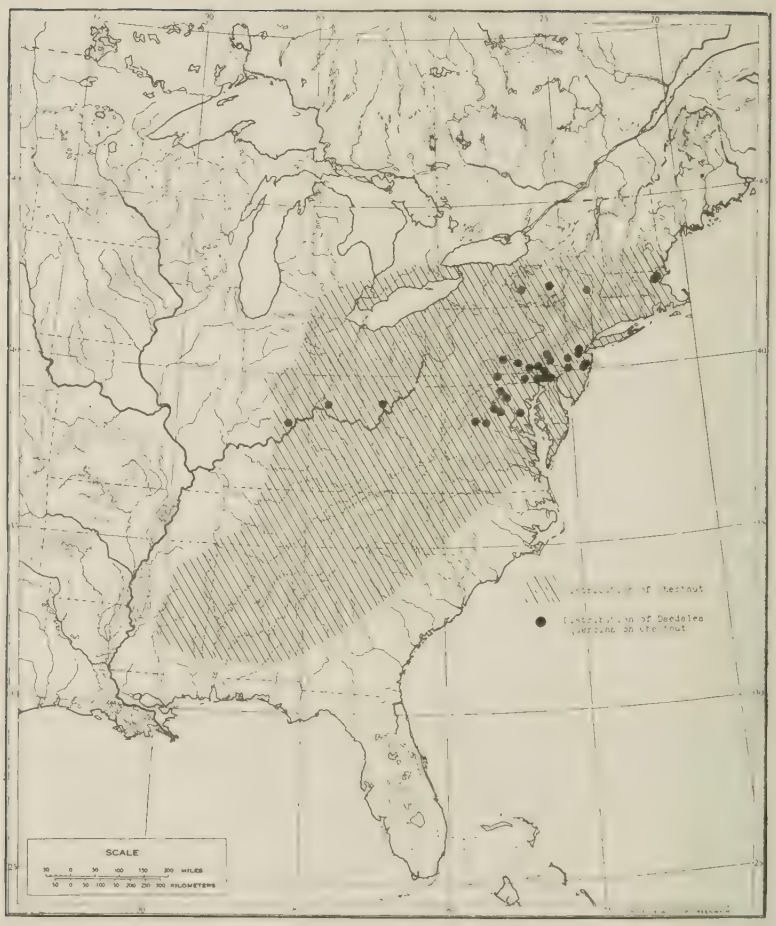
ONE of the most vital problems which concern the application of sound forest principles in the United States is the effective utilization of the wood in our diseased virgin forests. In recent years the devastation of the chestnut by the blight in southern New England, southeastern New York, Pennsylvania, Maryland, Virginia and, more recently, in the southern Appalachian forests, has rightly focused attention upon the necessity of salvaging the blight-killed timber. It is realized that this dead timber will eventually deteriorate by decay or by checking.

As the agents responsible for this decay are largely the Hymenomycetes, it is rational to assume that a study of the occurrence of the more important fungi and their prevalence should lead to a better understanding of the decays and type of utilization of this killed chestnut.

In comparison with oak and many other closely related hardwoods, chestnut is not infected with a large number of wood-destroying fungi. Many of the more common fungi such as *Polyporus sessilis*, *P. curtisii*, *P. obtusus*, *Fomes applanatus*, *F. igniarius*, *F. everhartii*, *P. rheades*, *Daedalea ambigua*, *Stereum subpileatum*,[1] *S. frustulosum* and others which occur on other common and closely related hardwood hosts,[2] either are not found or else they very rarely fruit on chestnut. In general, it can be stated that, although the most destructive fungi which are found on chestnut wood are limited to a comparatively few species, these forms are prevalent

[1] One collection in the Atkinson Herbarium.

[2] All are common in parts of the country on species of the closely related genus Quercus. *Fomes igniarius* has been collected on *Castanopsis chrysophylla* A. D. C., as shown by plants in the herbarium of the Plant Disease Survey and in the Pathological Collections, Washington.



MAP 3. The distribution of chestnut and of *Daedalea quercina* on *Castanea dentata*

throughout the entire range of the chestnut. With the exception of *D. quercina*, which appears to be limited to the area in northern Virginia and north of Virginia (see Map 3), and *Corticium caeruleum* (Schrad.) Fr., which is distinctly southern, the forms which are

common on chestnut in the Adirondacks and in New England are commonly found throughout the Alleghenies, the southern Appalachians, the regions of the southern limits of the chestnut in Alabama and on the west in Michigan.

Although different forest types in which *Castanea dentata* occurs offer different habitats for the chestnut fungi, the same species of fungus are found generally in all these varied forest types. With few exceptions it is possible to find the same fungi present on chestnut where this tree grows upon the dry rocky slopes covered with chestnut oak, black locust and pitch pine that may be found on chestnut where this tree occurs in the more moist yellow poplar, red oak and even rhododendron habitats.

In addition to the collections made in practically all states where chestnut is an important timber tree, the fungi found on this host in the following herbaria have been studied and are, in part, listed in this paper: New York Botanical Garden, Brooklyn Botanic Garden, Missouri Botanical Garden, Farlow Herbarium, Atkinson Herbarium, collections in the Office of Forest Pathology, Office of Pathological Collections and the University of North Carolina. The writer is indebted to the curators of these herbaria for privileges granted to him; to H. Bourdot for his valuable opinion regarding some of the species of the Thelephoraceae mentioned; to Dr. C. H. Kauffman for his opinion relative to some of the fungi studied; and particularly to Mr. G. F. Gravatt and other members of the Office of Forest Pathology for valuable help in making collections of fungi found on chestnut in the field and for their suggestions during the course of this study.

THE FUNGI WHICH PRODUCE DECAY IN CHESTNUT SAPWOOD

In the northern part of its range, Nellis (23) found the sapwood of dead standing chestnut subject to decay, usually within two years after the tree had been killed by blight. These observations, in a general way, correspond to the records obtained by Baxter and Gill (1) for chestnut in the southern Appalachian Mountains. The fruiting-bodies of the geographically widely distributed wood-destroying organisms which produce this decay can withstand much of this desiccation without losing their vitality. They are

also capable of reviving upon the restoration of favorable moisture conditions. This ability to recover from desiccation probably accounts for the wide distribution of sap-rotting organisms on the chestnut which grow on dry sites as well as on that found in more moist situations. For example, the fruiting-bodies of *Polystictus pargamenus*, *P. versicolor* and *P. hirsutus*, fungi which produce serious decays in chestnut sapwood, retain their vitality for several years after desiccation. *P. pargamenus* is reported by Buller (7) to have retained its vitality after one year of drying, *P. hirsutus* for three years, and *P. versicolor* for as long as four years. Such fungi are, therefore, capable of surviving any temporary periods of drought and, with the advent of rain, revive, shed spores and continue to develop.

Of the several fungi listed later in this paper, *P. pargamenus*, *P. hirsutus*, *Polyporus cinnabarinus*, *P. gilvus* and *Irpex tulipifera* are to be regarded generally as the most destructive of sapwood decay-producing polypores to both standing and fallen chestnut wood. These fungi are not only widely distributed throughout the range of the native chestnut, but occur also on hybrid stock in orchards and on both the Chinese (*C. mollissima* Blume) and Japanese (*C. japonica* Blume) stock.

The first two fungi mentioned are commonly found on standing fire- and blight-killed timber which still retains its bark. In such timber the decay often extends throughout the sapwood and deeply into the heartwood. The blight-cankered areas are usually the last portions of the wood to be attacked. In many trees the bark loosens from such areas first and these cankered areas of dried outer wood may remain sound for several years (Pls. XXXII and XXXIII, Fig. 1). If storage conditions are favorable for fungous growth, both *P. pargamenus* and *P. gilvus* are capable of producing additional decay in such blight- and fire-killed timber when it is felled and stored for long periods in the yards of the extract plants. The figures recorded in Table I indicate the relative abundance of the fruiting-bodies of the sapwood-destroying fungi which were found on two-year-old slash on the Natural Bridge National Forest in Virginia.

This group of fungi is found on logs, telegraph and telephone pole

TABLE I

THE COMMON AND MOST IMPORTANT FUNGI WHICH DECAY CHESTNUT SLASH

Figures based upon 1000 measurements for each diameter class for two-year-old slash on and off ground, Natural Bridge National Forest, Virginia

Diameter of outside bark	Fungi found in August, 1928															
	Polystictus hirsutus		Polyporus cinnabarinus		Irpex tulipifera		Stereum sp.		Stereum fasciatum		Schizophyllum commune		Polystictus versicolor		Stereum Och. flavum	
	On ground	Off ground	On ground	Off ground	On ground	Off ground	On ground	Off ground	On ground	Off ground	On ground	Off ground	On ground	Off ground	On ground	Off ground
1	6	5	3	0	3	2	3	1	1	1	2	2	5	1	2	1
2	8	0	18	1	4	7	6	0	2	0	1	4	2	0	2	1
3	8	5	17	0	1	2	0	2	2	1	0	0	0	0	0	3
4	9	3	12	0	0	2	1	1	3	0	0	2	0	2	0	0
Over 4″	11	6	8	0	0	1	0	0	2	0	1	0	0	0	0	0
Totals	42	19	58	1	8	14	10	4	10	2	4	8	7	3	4	5
Grand total	61		59		22		14		12		12		10		9	

timbers, fence posts, rails, acid wood and slash in the forest. In chestnut seasoned on the stump, their activities are generally confined to the sapwood, and the heartwood is seldom attacked. The outer layers of heartwood are commonly disintegrated, however, if moisture conditions are favorable for the continued growth of the mycelium. The bark, which clings to the wood for several years after the death of the tree, prevents evaporation of moisture and as a result the outer layers of wood are soon rendered worthless through decay.

The first evidence of rot in the standing tree is the appearance of small, irregular bleached areas which become individual decay centers. The decay spreads in all directions, the centers of decay soon coalesce, and the wood is reduced to a pithy condition, light in weight and soft. This completely decayed sapwood, as in wood decayed by *P. pargamenus*, is frequently bounded by a dark zone at the outer ring of the heartwood. The rather sharply defined sapwood peels, then flakes away, leaving the heartwood exposed in the standing tree. Such trees have been known to remain practically sound for at least twenty years.

Additional sap-rotting fungi which are found more or less frequently on chestnut are mentioned in the following sections.

AGARICACEAE

Comparatively few species of the Agaricaceae produce important decays in chestnut sapwood.

Schizophyllum commune Fr., *Panus stipticus* Fr. and *P. rudis* Fr. are to be seen wherever fallen limbs, slash, stumps, acid wood, mill slabs and chestnut ties are found in the East. *Pleurotus ostreatus* Fr. produces a white rot of both the sapwood and heartwood in logs in the southern Appalachians, but this fungus is not generally common on this substratum and so it cannot be considered important with reference to the decay of slash. Although *Mycena corticola* Fr. is found everywhere on chestnut bark and particularly on the bark of fire- and blight-killed timber, it probably has more effect in loosening the bark from the tree than in causing a rot of the sapwood.

In chestnut orchards, woodlots and forests, it is not uncommon

to find groups of trees infected with root rot. *Armillaria mellea* Fr. has been studied especially on chestnut and oak (20), on which it produces a soft, white watery decay in the bark and wood. Black lines often appear in the decayed wood. The felted mycelium, the flattened whitish strands and dark-colored rhizomorphs are commonly seen beneath the outer bark on dead standing chestnut and on the upturned roots of wind-thrown trees in the forests (Pl. XXXIII, Fig. 2).

Clitocybe illudens Schw. also occurs on and around old chestnut stumps or decaying roots and produces a whitish sap rot in the wood.

Hypholoma sublateritum Fr. causes a white rot in slash and has been collected on acid wood. Other species of this genus, such as *Hypholoma appendiculatum* Fr., and of other genera, such as *Collybia dryophila* Fr. and *C. butyracea* Fr., are found about stumps, but it is believed that plants like these occur on humus chiefly and that they aid in bringing about the last stages of disintegration of the chestnut wood.

Paxillus atrotomentosus Fr., *P. panuoides* Fr., *Omphalia campanella* Fr. and *Marasmius rotula* Fr. probably belong to this class of fungi, which aid in the humification of the disintegrated wood in the forest. Although *Collybia confluens* Fr. is reported (15) on fallen leaves, it is also found in the forest on badly decayed chestnut logs. *Collybia velutipes* is likewise found on decaying stumps.

Since information is meager regarding the extent to which species of the lignicolous genus, Flammula, are limited in their occurrence by the nature of the wood, it is of interest that both native and exotic chestnut can be listed as substrata. *Castanea japonica* may be cited as a substratum for *Flammula spumosa* Fr.–Ricken. Atkinson collected an unknown species of this genus in New York [3] on native chestnut, but did not determine its identity. *F. flavidella* Murrill was described from a specimen collected on a chestnut stump at the New York Botanical Garden.[4] Although plants of the genus Flammula usually occur in our northern forests, one species was collected in great abundance in the high Blue Ridge Moun-

[3] Atkinson Herbarium 10289 and 10292.

[4] Kauffman believes this species is "clearly a Naucoria."

tains of Virginia on native American chestnut, where it produced an indeterminate white sap rot in the slash.

This species, which may be described later as a new one, occurs abundantly on chestnut logs, and particularly on fire-charred logs, railroad ties and slash in the vicinity of Alto, Virginia. It is allied to *F. highlandensis* Pk., but seems to be distinct from it by the combination of the following characters: slightly smaller spores, the mild taste, the presence of cystidia (cystidia may also be present in *F. highlandensis*), the lemon-yellow color when it is young, and the habitat. An undescribed plant in the University of Michigan Herbarium collected by Dr. C. H. Kauffman seems to be closely related to, if not identical with, this Virginia plant.

The pileus of the Virginia plant is 2–3.5 cm. broad, pliant, convex, more or less viscid or subviscid, pellicle somewhat separable, yellowish orange. Flesh "ochraceous-orange" [5] to "zinc orange," darkening but slightly upon drying, rather thick. Gills adnate-subdecurrent, crowded. "Yellow ocher" to "ochraceous-tawny." Stem hollow, floccose-scaly, "primuline yellow," curved or bulbillose at attached base. Spores oblong, smooth, frequently one-guttate 5–6.5 × 3–4 μ, pale ochraceous under the microscope, "fuscus-brown" in mass. Cystidia on sides and edge of gills, flask-shaped to subcylindrical, variable 22–30 × 6–16 μ, subhyaline or brown, metalloid cysts present in hymenium. Odor and taste slight or mild. Common near Alto, Virginia, on chestnut slash and railway ties.

In addition to differences in microscopic structure, the pileus and stipe of the dried specimens of *F. highlandensis* Pk. are much thinner than those of the plant just described and the colors are less brilliant. In *F. highlandensis* the colors of both the stipe and pileus are nearly a uniform "cinnamon-buff." The gills are "tawny-olive."

The very closely related genus, Pholiota, which is characterized among the ocher-spored agarics by the presence of a membranaceous annulus, never cobwebby as in Flammula, is also in part lignicolous. Although no species of this genus have been collected

[5] Ridgway color standards are used throughout this paper for colors given in quotation marks.

in the southern Appalachians on chestnut, *Pholiota adiposa* has been found growing from the wounds six feet up the trunk of a chestnut tree in Milwaukee County, Wisconsin (4).

POLYPORACEAE

All the wood-inhabiting genera of the Polyporaceae grow on *Castanea dentata*. *Cyclomyces Greenei* Berk., the sole representative of this terrestrial genus, has been collected on the humus at the base of a chestnut. *Merulius fugax* and *M. tremellosus*, which are common to a great number of hardwood substrata, are found on chestnut. As on hickory, *Favolus canadensis* Klotzsch grows on the small fallen twigs, but is not abundant and cannot be considered important in slash decay. As regards decay, the genus Lenzites is more important than the genera just mentioned. *Lenzites betulina* and particularly *L. vialis* are widely distributed and grow upon chestnut trees and other structural timbers as well as upon slash in the forest. In addition to *Trametes cinnabarina*, *T. sepium* may be cited as another representative species of this genus. *T. sepium* (Pl. XXXIV) is to be found almost invariably on chestnut poles and other structural timbers.

Trametes dependens (B. & C.) Baxter, comb. nov. (*Polyporus dependens* B. & C. [*Ann. Nat. Hist.*, 2: 12. 1853; Greviller, 1: 37. 1872]) is the most unusual polypore found on chestnut and is perhaps one of the rarest species of this genus in America (see Pl. XXXV, Figs. 1–2). Lloyd states: "If this is not an anomaly of some kind it is a very curious thing. . . . It is a small plant about one-half inch in diameter and very rare, being found originally by Curtis in South Carolina and later by Ellis in New Jersey, who sent his plants to Cooke to be named. At Kew there is also in the same cover what appears to be the same plant from Africa." Lloyd received a specimen of *Trametes* (*Polystictus*) *dependens* from G. C. Fisher in Florida and it is this plant which he pictures in his mycological notes (17). It is reported on pine in these notes. Murrill (21) lists North Carolina in addition to New Jersey and South Carolina.

Evidently *T. dependens* is an eastern and southeastern plant. Because of its brown color, which closely resembles that of brown decayed chestnut wood, and because of its pendant habit on the

under side of the prostrate wood, detection of this fungus is very difficult in the forest. The writer collected *T. dependens* on the under surfaces of decayed chestnut wood which had fallen from a hollow tree and had gathered in a conical heap at its base (Black Mountain, North Carolina). The context, color and pores of this plant resemble those of *Polyporus cinnamomeus* Fr. In habit of growth and in the deeper color of the spores, it is distinct. The somewhat silky-fibrillose upper surface of the pileus is "Sudan brown"; pore surface is "Argus brown." The fruiting-bodies are usually centrally stalked, the cylindrical stipe enlarging as it approaches the pileus. The stipe is 1–4 mm. long and is of the same color as the pileus. Some of the fruit-bodies coalesce and form surfaces 4 cm. long. Some small fruiting-bodies are only 2 × 2 mm. Other individual fruiting-bodies measure as much as 2 cm. in width. Tubes as much as 5 mm. long, large angular mouths, 1-2 to a millimeter, context averaging 0.5 1.0 mm. wide and of the same color as the tubes. Spores brown 6–8 × 4–5 μ; hyphae thick-walled, 3 6, mostly 4 μ in diameter. The position of the tubes and their structure in relation to the context as shown by slides made from fixed material conclusively demonstrate that this plant should be placed in the genus Trametes.

Because of the lack of contrast between the fruiting-body and the substratum, it is very difficult to obtain good photographs of this plant on wood. Lloyd has enlarged his plants six diameters in the photographs shown in his notes.

The names *Polystictus dependens* (B. & C.) Sacc. and *Coltriciella dependens* (B. & C.) Murrill have been applied to this plant.

Daedalea confragosa Fr., which grows on a variety of woods such as Quercus, Crataegus, Acer, Betula, Salix and Nyssa, produces a white sap rot and heart rot of the small branches and twigs of Castanea. Other species of this genus are *D. unicolor*, which inhabits chestnut slash and *D. quercina*. (*D. quercina* is also listed with the fungi which cause decay in heartwood.)

Irpex tulipifera (Pl. XXXVI) occurs perhaps most abundantly on dead chestnut sprouts and limbs. *I. cinnamomeus* also destroys slash sapwood with varying degrees of rapidity, but it is not so common as the species mentioned previously.

It is significant that species of the genus Fomes rarely occur on chestnut and it is of additional interest to note that only a very limited number of different species of the genus are reported on this tree. (See the discussion on the fungi which produce decay in chestnut heartwood.)

The genus Polystictus has been mentioned previously. *Polystictus versicolor* and the closely allied *P. hirsutulus* Schw. are found on sticks and aid chiefly in the disintegration of slash. *Polyporus nidulans* Fr., *P. adustus* Fr., *P. pubescens* and *P. pocula* Schw. ex Berk. and Curtis occur on rails, dead branches, limbs and on structural timbers, especially on timber which still retains its bark, bridge cribbings for example. Like *P. gilvus*, *P. nidulans* is found in chestnut orchards both on native stock and on *Castanea japonica*. *P. pocula*, a species which is not uncommon on oak and which has been collected on Juglans, is also found on the smooth dead branches and sprouts of chestnut. Overholts also (24) reports this "on dead branches, especially of oak and chestnut." The white rot produced can be observed first as small whitened spots just beneath the fruiting-bodies. Although this fungus is widely distributed and is commonly collected on chestnut and although cultures of it exhibit a rapid growth of the mycelium, *P. pocula* cannot be listed in the class of organisms which produce a large percentage of the decay in chestnut. *P. chioneus* Fr. is a rather common representative of the plants which belong to the "soft and watery section" of this genus. It has been found on the bark of dead chestnut and on chestnut extract wood stored in the stacks. *P. galactinus* Berkeley and *P. semipileatus* Pk. have also been found on chestnut.

The porias reported from chestnut are:

Poria cinerea (Schw.) Cooke?
Poria contigua Fr.
Poria cruentata Mont.*
Poria ferruginosa (Schrad.) Fr.
Poria medulla-panis (Pers.) Cooke
Poria mucida Fr.
Poria mutans Pk.
Poria mutans var. tenuis Pk.
Poria punctata Fr.
Poria purpurea (Hall) Cooke
Poria semitincta (Pk.) Cooke
Poria subacida Pk.
Poria tenuis (Schw.) Cooke
Poria vulgaris Fr.

Of this number *P. ferruginosa*, *P. medulla-panis*, *P. mucida*, *P. mutans* var. *tenuis*, *P. semitincta*, *P. subacida* (Pl. XXXVII,

* Species imperfectly understood.

Figs. 1-2) and *P. tenuis* are the most common. *Porothelium fimbriatum* Fr. can also be placed in this list.

Although these plants produce decay in sapwood, several species are commonly collected on heartwood also. *Poria mutans* Pk., which was originally described from a specimen collected on chestnut wood, is a particularly good example of this (Pl. XXXVIII). I have collected *P. mutans* on oak and it is probably found on other deciduous woods, but chestnut seems to be the common habitat for it. The numerous collections of it which have been made on chestnut in Virginia, West Virginia, Tennessee, New York, North Carolina, New Jersey and Alabama indicate that it is commonly distributed throughout the range of the chestnut and that chestnut is the common substratum. This poria is found on the ends of old logs and in the hollow butts, where it is associated with a pocketed rot. Frequently the decay is advanced so far that the logs attacked consist of only concentric layers of reddish-brown rotten wood which are loosely held together. The type of decay which is associated with it is, therefore, very similar to that produced by *Polyporus pilotae* (Pl. XXXIX, Fig. 2). Not only are the two decays likely to be confused, but it is possible that, without a critical examination, the fruiting-bodies of *P. mutans* might be mistaken for a resupinate form of *P. pilotae*.[6]

Few fungi occur on charred logs and the decay of burned slash is commonly a slow process. *P. mutans* is frequently found on such wood and can be listed in the limited group of fungi which attack it.

Poria ferruginosa and *P. viticola* occur on a great variety of hardwood species. They are alike in their habit of growth; on chestnut they are usually found on both fallen and dead standing sprouts. The fruiting surfaces of these porias have been observed almost covering dead sprouts as large as ten inches in diameter and this growth habit is also characteristic for the fungi on fallen slash. The plants fruit on the bark and the wood, and even on old leaf surfaces which cling to the down wood. Both fungi usually develop best in the more moist situations, where they attack the dead wood and produce an indeterminate white rot. The sapwood

[6] The name *P. pilotae* has appeared extensively in American literature. *P. pilotae* is considered a synonym of *P. croceus* Fr. by some authors.

is first attacked and it is not infrequent to find it entirely decayed around the sprouts before the heartwood is severely attacked (see Pl. XXXIX, Fig. 1).

Poria mucida Fr. is one of the most prevalent of the porias found on chestnut and is perhaps one of the most variable species known. It produces an indeterminate white rot of both chestnut and oak. It attacks chestnut slash of all diameter sizes in the forest and appears on both the bark and on decorticated logs, ties, posts, and particularly on dead sprouts and chestnut acid wood.

The identity of *P. mucida* has caused much confusion in mycological literature. Romell (26) has pointed out that at least some of the specimens of Persoon's *Pol. mucidus* are identical with Bresadola's *Poria mollusca*.[7] The *P. mucida* of Bresadola seems to be *Pol. versiporus*[8] (*P. radula*) and Romell adds: ". . . according to a specimen in Uppsala Fries referred Persoon's *P. mucida* to *P. Vaillantii*. Bresadola has given the name *Vaillantii* to another plant." Since neither Persoon's nor Bresadola's plant is slimy in nature, Romell would use some such name as *P. radiosa* or *fimbriata* for Persoon's plant. *Irpex deformans*, *P. radula* and several other names have been applied to this fungus. Figure 2 of Plate XL illustrates *P. mucida* Pers: forma *P. radula* sensu Quélet, not Bres. This form is very common on chestnut.

Although it seems impossible to tell what the authentic species of *P. mucida* Fr. is, this name is established by usage in America and refers to a variable form which integrates from a poroid and sinuose form to an irpiciform condition. (For pore structure compare the forms of *P. mucida* illustrated in Pl. XL, Figs. 1–2, with those of *P. sinuosa*[9] of Fig. 3.) Specimens collected on chestnut wood and identified by Bourdot agree with the following description:

[7] I have studied these plants at Stockholm. The *Poria mucida* labeled *Poria mucida* Pers. is a snow-white plant and is unlike the "warm buff" plant named *P. mucida* in America.

[8] According to my interpretation *P. versiporus* has tubes longer than those of *P. mucida*.

[9] The spores of *P. sinuosa* are different from those of *P. mucida*. According to specimens at Stockholm, the spores of *P. sinuosa* measure 5–7 × 1–1¼ μ (Romell). *P. sinuosa* is usually on conifers also.

Spores of a plant in Stockholm labeled by Romell as *P. versipora* f. *abieticola* measure 4½–5 × 3–4 μ. This plant is on coniferous wood.

Plant effuse, forming patches on wood and bark, somewhat coriaceous, inseparable, usually 1 2 mm. thick, margin whitish or buff, slightly pubescent, irregular, mostly fertile, tubes "warm buff" (Ridg.), mostly 0.5–1.0 mm. long, mouths lacerate, 2–3 per mm., frequently irpiciform, basidia 12–14 × 5 μ, spores 4–6 × (5 × 3)3 μ, hyphae incrusted, 1–4, mostly 2 μ wide, clamp connections present.

P. pulchella (Schw.) Cooke and *P. tenuis* [10] (Schw.) Cooke may be included in the *P. medulla-panis* Fr. group of fungi, which are common on chestnut. The yellow plant, *P. pulchella*, is considered synonymous with *P. medulla-panis* and is widely distributed, not only on chestnut logs, slash, extract wood, fence posts and rails, but also very frequently on *Robinea pseudoacacia*, *Prunus serotina*, *Hicoria ovata* and the various species of oak.

The spore and hyphal characters of *P. tenuis* are similar to those of *P. medulla-panis*. In general, the tube walls of *P. tenuis*, as here interpreted, are somewhat thinner, but no difference has been noted in their length. Although small tubes (0.5 mm.) are to be seen in the plants in the Michener collection, it is believed that the tube length in this plant is a quite variable character. The species shows a broad margin which ramifies over the fallen chestnut branches (Pl. XLI). Under favorable moisture conditions the plant may become somewhat rhizomorphic. Characteristic forms of this plant are softer, more pliable and leathery than typical specimens of *P. medulla-panis* and do not tend to crack upon drying — at least to the extent exhibited by the species last mentioned.

The mycelium of both *P. medulla-panis* and *P. tenuis* is predominantly white in culture when grown in the diffused light of the laboratory for six months on malt extract agar. (Some cultures white to "cartridge-buff" [Ridg.].) This color variation has been

[10] The plant which is here designated as *P. tenuis* (Schw.) may be found frequently in herbaria under the name *P. omoema* (Berk.) E. & E. Eventually the two porias may be considered identical plants. Bresadola believes that *P. omoema* is identical with *P. subacida*. The American concept of *Poria subacida* is very different from that of Bresadola's, and American mycologists, in general, separate plants of the *P. subacida* type from those of the *P. pulchella–P. medulla-panis* group. At least some plants labeled *Polyporus holoxanthus* B. & C. fall in this last-mentioned group. The group will be the subject of another paper.

noted in nature for *P. medulla-panis* and is a variation which has formed a basis for the separation of *P. pulchella* from *P. medulla-panis.*

Small strands of mycelium or rhizomorphs are distinctive and appear on the inoculum in cultures of *P. tenuis,* but have not been noticed in cultures of *P. medulla-panis* (see Pl. XLII, Fig. 2). *P. medulla-panis* has fruited in the diffuse light of the laboratory (Pl. XLII, Fig. 1), but cultures of *P. tenuis* have not shown any indication of hymenophore formation when grown under similar conditions.

THE FUNGI WHICH PRODUCE DECAY IN CHESTNUT HEARTWOOD

The fungi which attack the heartwood of chestnut are also limited to a comparatively few species which are generally prevalent throughout the entire range of the chestnut. Chestnut, however, happens to be one of the most common woods attacked by certain species of this group. *Daedalea quercina,* for example, is generally limited to chestnut and oak. This fungus has been found on willow,[8] *Juglans cinerea* [9] and Prunus,[10] but such substrata are unusual for it.

Within the limits of its distribution, *D. quercina* fruits abundantly on chestnut and oak logs, stumps, standing blight-killed trees and structural timbers. It is found frequently in a fruiting condition in the checks of pole timbers and blight-killed chestnut, where it produces a brown decay of the wood. Plates of buff-colored mycelium — which are somewhat darker than those ordinarily produced by *Polyporus spraguei* — are formed in the checks. Insect tunnels are nearly always filled up with the strands of mycelium. The wood which surrounds such tunnel-filled areas is frequently sound. In fact, the fungus frequently spreads out through apparently sound wood by means of such tunnels.

It has been mentioned that *D. quercina* (Pl. XLIII, Fig. 1) has not been found on chestnut throughout the natural range of this

[8] C. G Lloyd Herbarium.

[9] Brooklyn Botanic Garden Herbarium.

[10] Spaulding, Perley, writes in a private communication: "I have found it on this genus in three states: Pennsylvania, Massachusetts, and Connecticut."

tree.[11] The fungus is to be collected, but not commonly, on oak in the oak-chestnut forest types in the southeast. *D. quercina* is common in Ohio as far north as Put-in-Bay, but it is rather rare in southern Michigan on oak and it has not been collected on chestnut. There are two collections on oak from Michigan in the writer's private herbarium and only one collection is listed in the catalog of the University of Michigan Herbarium.

Whether it is the higher tannin content of the chestnut which grows south of the Potomac River, or the difference in the whole gamut of climatic factors farther south, or the actual presence of fungus but its failure to fruit, that accounts for the apparent limits of distribution of *D. quercina* cannot be stated. It would appear that moisture conditions or climatic factors would duplicate northern conditions at least in some of the chestnut-timbered areas of the mountainous sections of the southern Appalachian territory and in some of the various forest types.

It is a singular fact that decay in chestnut heartwood is not generally caused by any species of the genus Fomes. Even *Fomes applanatus,* one of the most cosmopolitan of all of the hardwood-inhabiting fungi (twenty-six genera are listed by one investigator [32]), is seldom found on chestnut. It is not reported on chestnut, so far as the writer could determine, in the rather extensive literature which deals with *F. applanatus,* and practically no collections of it on chestnut are to be found in the larger herbaria of the country. One collection was made on a chestnut in pure chestnut timber near Alto, Virginia, on the Natural Bridge National Forest. It seems certain that it does not occur on *Castanea dentata* frequently enough to be of any importance in bringing about the decay of the larger pieces of slash in the forest. The rot produced in chestnut is similar in type to that already described for other species (32).

Weir (30) reports *F. everhartii* on chestnut in Indiana. Although *F. everhartii* causes the most important heart rot of oaks in Michi-

[11] Only two collections of *Daedalea quercina* have been made as far south as Alto, vicinity of Buena Vista, Virginia. They were made at a high altitude (3,000 feet) on chestnut which had been girdled for thirty years previous to the time of examination of the timber. It is possible, however, that this fungus produces a butt rot of chestnut in the South and is not indicated in the records because it has not been found in a fruiting condition.

gan, it seems to be more prevalent in the North and has not been collected on *C. dentata* in the southern Appalachians. The allied *F. igniarius* has not been collected on chestnut in this country. I have found it, however, on this tree in the forest of Fontainebleau, near Paris, France. No reports of its occurrence on chestnut have been found in literature.

F. ohiensis Berk. ex Murr. is the most common of all of the species of this genus which are found on chestnut. It is usually collected on logs, standing poles and rails. *F. scutellatus* Schw. ex Cooke is found in similar habitats.

P. pilotae Schw. and *P. spraguei* (Pl. XLIII, Fig. 2) cause a large amount of the defect in both green and dead standing chestnut. Long (20) reports that fully seventy-five per cent of the chestnut examined around New Berlin, New York, had tops attacked by *P. pilotae*. I have found that 20 per cent of the seventy scattered wind-thrown trees which were examined in the Great Smoky Mountains of Tennessee were infected with the piped rot and thirty-six per cent showed evidences of the type of decay caused by *P. spraguei*. See Table II and also Plates XLIV–XLV.

TABLE II

Decay in Wind-thrown Chestnut, Sevier Co., Tennessee

No. trees	No. with no visible rot	Armillaria mellea	Fire scar	P. spraguei type		P. pilotae type	
				No.	Per cent	No.	Per cent
70	27	4	17	25	36	14	20

Breakage from ground					Dead	Living
At roots	1–4 feet	5–10 feet	11–16 feet	17+ feet		
7	21	18	11	13	17	53

In another study of this same region 1496 felled chestnut trees were examined. Sixty-six, or 13.7 per cent, of those on the lower slopes here showed evidences of the *P. spraguei* type of decay, and in 24, or 5.0 per cent, a rot was found similar to that already described by Long (19) for *P. pilotae*.[12] On the upper slopes and ridge-top sites in this same area 236, or 23.2 per cent, of the trees showed the *P. spraguei* type of defect and 79, or 7.7 per cent, were classed as piped rots. Fruiting-bodies of *P. spraguei* appeared on 110, or 7.3 per cent, of the trees in this area at the time of examination.

Cultures obtained from trees which had been in a dead standing condition for a varying number of years show that such fungi are capable of causing heart rots in dead standing timber as well as in green chestnut. It can be seen from Table III that all the cultures obtained from the *P. spraguei* rot types produced buff-colored mycelia in culture. The doubtful *Polyporus sulphureus* rot type

TABLE III

CULTURES ON MALT AGAR OBTAINED FROM DEAD STANDING CHESTNUT, GLENVILLE, NORTH CAROLINA

Plot	Tree number	Years dead	Section (0 = stump, 1 = 1st log, 2 = 2d log)	Rot type listed	Color of mycelium (Ridgway)
III	83	12	0	P. spraguei	Snow white to cartridge buff
II	40	30	0	P. pilotae	Pinkish-buff to light pinkish cinnamon
II	39	30	0	Unknown	Snow white to pinkish buff
V	39	30	1	P. spraguei	Pinkish buff
III	63	12	1½	P. pilotae	Ochraceous orange
III	53	12	1	P. spraguei	Warm buff
II	32	30	1	P. pilotae	Ochraceous buff
III	63	12	1	P. pilotae	Capucine yellow
III	82	12	0	P. pilotae	Ochraceous salmon to ochraceous orange
II	52	30	1	P. sulphureus?	Pale ochraceous buff
I	19	18?	2	P. pilotae	Light orange yellow
II	54	30	2	P. pilotae	Pinkish cinnamon
II	47	30	2	P. pilotae	Pinkish cinnamon

[12] Since *P. pilotae* does not fruit so abundantly as *P. spraguei* and some of the other lignicolous fungi, it is impossible positively to identify the causal organism, even though the rot seems characteristic. The words "*P. pilotae* type" and "*P. spraguei* type" are used when fruiting-bodies have not been found in all trees examined.

also produced buff-colored mycelia. In contrast to these cultures, those made from the *P. pilotae* rot types were orange or cinnamon without exception.

Although *P. spraguei* fruits abundantly in the field, as already indicated, pores have not formed in any of the cultures observed. *P. pilotae*, on the other hand, does not fruit abundantly in the field — at least to the extent exhibited by *P. spraguei*, but pore formation has occurred in some of the cultures taken from the dead wood.

Although *P. spraguei* is found on oak, beech and sometimes cherry, maple, ash, persimmon and other frondose wood, it is one of the most common members of the genus on standing chestnut throughout the range of *C. dentata*. It is found not only at the base of standing timber (frequently fruiting at fire scars), but also in logs, extract wood and structural timbers, in which it causes a subsequent decay. Sporophores frequently appear at the ends of logs and on stumps within a week or two after the trees have been felled; in smaller timbers, such as extract wood, the fungus has been seen to continue to fruit after a ten weeks' storage period. Undoubtedly this period may be longer if moisture conditions are favorable to the continued growth of the fungus. The statement (29) that they will continue to fruit on stumps as long as there is any sound heartwood agrees with the records which I have obtained. *P. spraguei* is one of the few fungi which are capable of destroying both standing timber and larger slash. The fruiting-body can be easily recognized by the fact that its margin turns dark olive-green when bruised and blackens when dried. *P. spraguei* is associated with a brown friable rot of the wood which splits into cubes somewhat similar to those recognized in the decay caused by *P. sulphureus*. Mats of the buff-colored mycelium fill the cracks. Worm holes, which are so common in chestnut wood, are usually filled with mycelium in infected trees, and this mycelium may penetrate through such tunnels deeply into wood that is otherwise free from defect. Fruiting-bodies have been found at the ends of logs as much as five inches distant from the wood which is actually decayed.

Fistulina hepatica Fr. occurs on both oaks and chestnut, but it is usually found at the base of chestnut stumps (Pl. XLVI, Fig. 1).

I have not found the rare *F. pallida* B. & Rav. although it has been reported on chestnut stumps. The details of the rot have not been studied. Some of the specimens of the wood on which *F. hepatica* have been found are very hard. Other samples exhibit white rot in the vicinity of the fruiting-bodies. Blackened areas shown in Plate XLVI, Figure 2, are usually associated with the decay.

P. sulphureus Fr. causes a red-brown rot which separates into cubes similar to those so commonly observed in oak decayed by it. The records of the various collections of *P. sulphureus* show that it is common on living trees, that it not only fruits near the base of such trees, but has been found fruiting as high as twelve feet in green standing timber. This fungus, which has been known to continue to live in girdled and blight-killed trees, causes a rot in chestnut fence posts, telegraph poles and railroad ties. *P. sulphureus* (Pl. XLVII) is one of the few fungi found in standing timber which is capable of continuing its growth in large pieces of slash and cull logs in the forest.

The "string and ray rot" described in oak by Long (19) is also found as a butt rot in chestnut. The descriptive term of this rot, though applicable for the oak rot, does not apply to a wood such as chestnut, which does not possess the broad conspicuous pith rays of the genus Quercus. Chestnut which are infected with this rot caused by *P. Berkeleyi* Fr. usually grow in the coves and ravines.

P. Berkeleyi usually fruits from a buried sclerotium which extends down to the roots or to some portion of the wood near the base of the tree. In oak, Long reports that the fruiting-body was never found growing on the bole of the tree above the surface of the ground. "There was no evidence," he adds, "to indicate that the fungus could fruit on the trunk after the trees were felled, even if the rot should continue to grow in the felled tree." These findings for oak correspond, in a general way, with the results recorded for this fungus in chestnut. During the course of these investigations only one specimen of *P. Berkeleyi* on chestnut was collected which was not fruiting at the base of the tree. This sporophore extended out from the top center of an old stump. The tree had been felled several years previous to the time of this collection.

THELEPHORACEAE [13]

The more common plants which are found on both standing and felled chestnut wood are listed as follows:

Aleurodiscus acerinus (Pers.) Hohn & Litsch [14]
Coniophora cerebella Pers.
C. olivacea (Fr.) Karsten
C. kalmiae (Pk.) Burt
Corticium auberianum Mont. (on *Castanea pumila*)
C. caeruleum (Schrad.) Fr.
C. confluens Fr.
C. hydnans (Schw.) Burt
C. lactescens Berk.
C. incarnatum (Pers.) Fr.[15]
C. portentosum Bk.?
C. scutellare B. & C.[16]
C. sulphureum Pers. not Fr.
Hymenochaete rubiginosa Dickson ex Lév. (usually on heartwood)
H. tabacina (Sow.) Lév.
Hypochnus subferrugineus Burt
Peniophora burtii Romell
P. cinerea (Pers.) Cooke
P. cremea Bres.
P. filamentosa (B. & C.) Burt
P. incarnata (Pers.) Karst
P. miniata (Berk.) Burt
P. pubera Fr.
P. roumeguerii Bres.
P. setigera (Fr.) Bres. forma grandinioides
P. velutina (DC.) Cke.
Stereum erumpens Burt
S. fasciatum Schw.
S. gausapatum Fr.[17]
S. hirsutum Willdenow ex Fr.
S. lobatum (Kenze) Fr.
S. ochraceo-flavum Schw.
S. purpureum Pers.
S. rameale Schw.
S. roseo-carneum (Schw.) Fr.
S. sericeum Schw.
S. subpileatum B. & C.
S. umbrinum B. & C.
S. versiforme B. &. C.
Thelephora terrestris Ehrh. ex Fr.[18]

S. rameale, S. umbrinum, S. versiforme, S. ochraceo-flavum (Pl. XLIX, Fig. 1), *S. hirsutum, S. fasciatum* and, in the South, *Corticium caeruleum* are all common sap-rotting fungi which produce "indeterminate" white rots, chiefly in slash. These forms and *Irpex tulipifera* Schw. cause most of the decay in blight-killed chestnut sprouts, which are recognized as a dangerous fire menace in the forest. Injuries, originally caused by the chestnut blight, sometimes serve as entrance points for the mycelia of such fungi.

[13] Additional species listed at end of paper.
[14] This species occurs on chestnut bark rather than on the sapwood.
[15] Burt gives this as a synonym, doubtful as to identity.
[16] *Corticium scutellare* B. & C. (Pl. XLVIII, Fig. 1).
[17] *Stereum gausapatum* Fr. (Pl. XLVIII, Fig. 2).
[18] Common at the base of chestnut trees in plantation, Saginaw Forest, University of Michigan. Decay cannot be attributed to this fungus in this plantation.

S. fasciatum decays the sapwood of the larger sprouts and limbs; *S. versiforme, S. umbrinum* and *C. caeruleum* occur on branches two or three inches in diameter; and such forms as *S. sericeum, S. roseo-carneum, Peniophora cinerea, Corticium auberianum* and *Phlebia contorta* usually attack the small twigs one inch or less in diameter. With the possible exception of *C. caeruleum,* all these fungi last mentioned may occur on *C. japonica* and *C. mollissima* as well as on the native chestnut.

Sound or slightly decayed decorticated branches, logs, posts, rails and structural timbers are commonly attacked by *Hymenochaete rubiginosa* (Pl. XLIX, Fig. 2). This fungus usually occurs on the larger decorticated trees which have been fire- or blight-killed for three or four years. Reëxaminations of the same chestnut trees located on permanent sample plots on the Natural Bridge National Forest and elsewhere have revealed the fact that this fungus frequently follows the more strictly sap-rotting fungi and attacks the heartwood of the dead trees after the sapwood has been decayed and weathered away. Although the fruiting-bodies of this fungus appear on the firm outer wood of logs in the forest, the activities of the mycelium are not confined to the sapwood. Frequently, as noted by Brown (5), it is not uncommon to find logs decayed to the core on the lower side, but these same limbs may be sound on the upper surface where the inroads of the mycelium have been arrested through lack of moisture. Chestnut wood decayed by this fungus is distinctively characterized by the presence of white cavities which are bounded by wood that has retained its original color.

Many of the foregoing plants such as *Coniophora cerebella* and *C. kalmiae* are found on the bark of standing and fallen trees and on products such as acid wood. *Peniophora filamentosa, P. velutina, P. miniata* and *Corticium confluens* are additional examples. Several imperfectly understood plants, new species and varieties, which belong to this group of chestnut-inhabiting fungi have been collected. Only a few of them will be discussed in this paper. The forms listed in this paper have been compared with plants deposited in the Herbarium of the Missouri Botanical Garden and also have been critically studied by H. Bourdot.

Peniophora sp. (Fig. 5). — Fructifications effused, closely adnate, thin, in small patches becoming confluent, whitish to whitish cream color, hyphae 2.5–4 μ wide, with thin walls, clamp connections scattered, thin-walled cystidia 45–75 $\times$ 6 μ, some immersed,

Fig. 5. *Peniophora sp.*

others projecting up to 40 μ; basidia 30 $\times$ 6 μ, spores oblong, subcylindrical, obliquely attenuated at the base 7.5–9 $\times$ 3–3.5 μ.

Fructifications 15 $\times$ 2 cm. on bark of chestnut sprout. Blue Ridge, North Carolina.

Peniophora roumeguerii Bres. — This plant, which is not common in America, was collected on small chestnut twigs in the Great

Smoky Mountains, near Gatlinburg, Tennessee. Bourdot states that it is identical with the European collections.

Peniophora setigera (DC.) forma *grandinioides*. —This plant is not listed by Burt. *P. setigera* may be described under the genus Grandinia or Odontia, according to Bourdot.

Corticium sp. (Fig. 6). — This plant is in all probability an undescribed Corticium. Specimens have been collected on chestnut limbs in the vicinity of Montgomery and also on chestnut near Birmingham, Alabama. There are very few known members of the genus Corticium which show non-colored pyriform gloeocystidia in section. The fructifications resemble in general aspect *C. radiosum*, the widely distributed plant which is usually found

FIG. 6. *Corticium sp.*

on conifers, and *C. pilosum*, which appears to be a southern plant.

In addition to the larger spores found in *C. radiosum*, there are differences in color and texture. Immature portions of the Alabama plants closely resemble the type specimen of *C. pilosum* Burt, which was found on *Alnus rugosa*. The spores described in *C. pilosum* are 6–9 × 3–4½ μ. Mature portions of these collections on chestnut wood are much more whitish and have not become pale olive-buff and pale smoke-colored in the herbarium.

The fructifications of the specimens which were collected on chestnut are effused, adnate when young, becoming somewhat separable in age; white to cartridge-buff, mostly whitish and resembling *Peniophora nuda* in general aspect. Hyphae indistinct, trama hypha hyaline, 20–50 μ thick; gloeocystidia numerous, mostly spherical, basidia 15 × 4 μ, spores 4.5 × 3 μ.

Fructification 5 × 3 cm. on bark and wood of *C. dentata*. Birmingham and Montgomery, Alabama.

Corticium subceraceum Burt (Fig. 7). — Fructifications effused, adnate, thin, "light ochraceous-buff" to "terra cotta" (Ridg.) waxy, the margin thinning out, large hyphae interwoven, incrusted 6–12 μ in diameter, small hyphae 3–4 μ in diameter. (The large hyphae of our collections thus differ from the description of the species by being incrusted.) Basidia 14 × 4.5 μ, spores 3–4 (4.5) × 2–2.5 μ.

Fig. 7. *Corticium subceraceum*

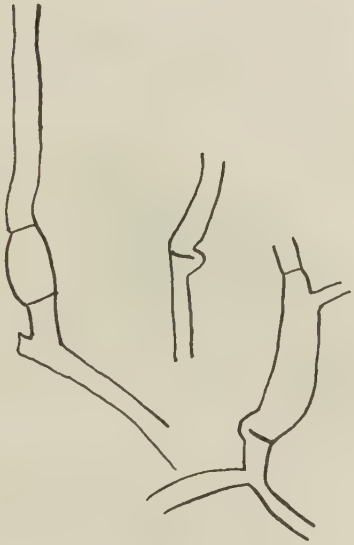


Fig. 8. *Coniophora kalmiae*

Fructifications 2–3.5 long and 1–2 cm. wide. On decayed wood of chestnut extract log, Buena Vista, Virginia.

Coniophora kalmiae (Pk.) Burt (Fig. 8). — On chestnut. Gordonsville, Virginia. *C. kalmiae* is distinguished by the occasionally

swollen portions of the hyphae, a character which has been used in separating this species from *C. arida*. Burt (9) states that these two fungi may not be specifically distinct. The majority of the specimens of *C. arida*, a species which is mentioned as an important timber destroyer by Burt, have been found by collectors on conifers, mostly pine. *C. kalmiae* is listed as a rare species by Burt. It occurs on "prostrate limbs and logs of frondose species, a single collection on hemlock spruce. Vermont and New York."

Corticium caeruleum (Schrad.) Fr. — The species is easily recognized by its deep navy blue to induline color and by the somewhat velvety nature of the fructification. This southern plant is found in quantity on the bark of dead chestnut sprouts and causes a white rot of both the heartwood and sapwood. It is also found on fallen oak branches in the South, but I have not collected it on chestnut north of Birmingham. Specimens are to be found also on pecan, grape, pear and maple, according to the collections deposited at the Missouri Botanical Garden. Coker (14) reports this fungus on privet and crêpe myrtle in North Carolina. *C. caeruleum* seems to be more abundant in Alabama than in any other southern state where chestnut grows.

Corticium auberianum Mont. — This rare plant, which was collected on chinquapin near Montgomery, Alabama, can be recognized by its thin snow-white fructification and small spores, 4–5 × 2–2.5 μ. The hyphae have thin walls and are somewhat incrusted. Scattered clamp connections are present.

Corticium sulphureum Pers. non Fr. — The several collections which have been made of this fungus near Black Mountain, North Carolina, and at Leesburg, Hotel Mons and Natural Bridge Station, Virginia, indicate that it is frequently found on the sapwood of chestnut and on badly decayed wood in the forests in the southeastern states. Extract wood seems to be the chief chestnut product on which it is found.

Romell, Bresadola and Burt place *C. sulphureum* under the genus Hypochnus as *H. fumosus* Fr. The habit and the hypochnoid structure of this plant certainly suggest the genus Hypochnus. According to Burt (8), "The species is best regarded as a hyaline-spored Hypochnus."

Merulius rufus Pers. — The specimens collected on the bark of dead standing chestnut trees near Mt. Pocono, Pennsylvania, are somewhat different in respect to hyphal characters from the typical specimens. The hyphae in the trama of these specimens have much thicker walls and measure 4–6 μ in diameter. Basidia 21–30 $\times$ 4–5 μ; spores 4.5 $\times$ 2.5 μ.

Sebacina deglubens B. & C.? — Fructification effused in crevices of the bark, "pale yellow orange" to "chestnut" (Ridg.). The hyphae of this variety are less thick, 2 3 μ in diameter, subparallel, the upper hyphae more entangled, clamp connections present, more compact and the walls less distinct; basidia immerged in filamentous paraphyses 9–12 $\times$ 8–9 μ, sterigmates 2.5 μ long, spores oblong, laterally appressed, and obliquely attenuated at the base, 6 (9) $\times$ 3.5–4 μ.

On bark of *Castanea dentata*, Montgomery, Alabama.

MERULIUS

Very little has been published regarding the decay produced by the various lignicolous species of this genus. On American woods *Merulius lacrymans*, according to Burt (10), is rather rare in the United States, but it has been the subject of many important papers in Europe. This species has not been found by the writer on chestnut. *M. tremellosus* Schrader occurs on the bark and badly decayed wood on chestnut trunks and a variety of other frondose woods such as *Populus grandidentata*, *Acer spicatum*, *Liquidambar styraciflua*, *Quercus alba* and other oaks, and on apple. Hemlock is also a substratum for this species. *M. terrestris* (Pk.), which is reported (10) on the earth walls of cellars and in greenhouses, has been found on a chestnut log and identified by Weir. Another species, *M. corium* Fr., is also reported on chestnut (30). *M. fugax* Fr., which is the most striking and common species of this genus and which is usually found on coniferous species of trees, has been collected on chestnut in Pennsylvania and also in Tennessee.

HYDNACEAE

The resupinate Hydnaceae and many other Hydna are in such a state of confusion that it is possible at this time to list only the

plants which have been named. *Steccherinum adustum* (Schw.) Banker is rather commonly found on chestnut branches in the southeast. This sessile or stalked plant is easily recognized in the field by the fact that the teeth in fresh plants turn dark when bruised. *Hydnum ochraceum* is common on chestnut bark and sticks. *H. fuscoatrum* Fr., *H. himantia* Schw., *H. xanthum* B. & C., *Odontia arguta* (Fr.) Bres., *O. bugellensis* Fr., *O. granulata* Burt, *O. hydnoides* Schw., *O. nivea* Karst, *O. trachytricha* B. & C. have all been found on chestnut, or they have been reported in the literature as chestnut-inhabiting fungi.

Phlebia strigosozonata (*P. pileata* Pk.) Schw. has been collected on acid wood and *P. contorta* has even been found on small chestnut branches. *P. radiata* Fr. has been collected on decayed chestnut bark.

LIST OF BASIDIOMYCETES

This is a résumé of the basidiomycetous fungi on the genus Castanea reported in this paper and elsewhere in the literature. An asterisk (*) refers to plants reported once. A dagger (†) indicates foreign plants which have not been found in this country on chestnut.

Aleurodiscus acerinus (Pers.) von Holn. & Litsch.
Armillaria mellea Fr.
Clitocybe illudens Schw.
Collybia butyracea Fr.
C. confluens Fr.
C. dryophila Fr.
C. velutipes Fr.
Coniophora cerebella Pers.
C. kalmiae (Pk.) Burt
C. olivacea (Fr.) Karst
Corticium auberianum Mont.
C. caeruleum (Schrad.) Fr.
C. confluens Fr.
C. hydnans (Schw.) Burt
†C. illaqueatum B. &. G.
C. lactescens Berk.
*C. laetum Karst
†C. lividum Pers.
C. portentosum Bk.?
*C. roseum Pers.
C. scutellare B. & C.
C. subceraceum Burt
C. sulphureum Pers. non Fr.
*Cyathus striatus (Huds.) Hoff.
*C. vernicosus (Bull.) DC.
*Dacryomyces deliquescens (Bull.) Duby
Daedalea confragosa Fr.
D. quercina Fr.
D. unicolor Fr.
Favolus canadensis Klotzsch
Fistulina hepatica Fr.
F. pallida B. & Rav.
Flammula flavidella Murr.
F. spumosa Fr.
*Fomes applanatus Pers. ex Wallroth
*F. everhartii Ellis and Galloway
†F. griseus Laz.
F. igniarius Linn. ex Gillet
†F. korthalsii (Lév.) Cooke
F. ohiensis Berk. ex Murr.
F. scutellatus Schw. ex Cooke
*F. ungulatus Schaeff
†Hexagona minor Lazaro
*Hirneola auricula-Judae (L.) Berk.
*Hydnum farinaceum Pers.
H. fuscoatrum Fr.

*H. himantia Schw.
H. ochraceum Gmel.
H. xanthum B. & C.
*Hymenochaete corrugata Lév.
*H. episphaeria (Schw.) Massee?
H. rubiginosa Dickson ex Lév.
H. tabacina (Sow.) Lév.
Hypholoma appendiculatum Fr.
H. sublateritum Fr.
Hypochnus fuscus Fr.
H. subferrugineus Burt
Irpex cinnamomeus Fr.
I. tulipifera Schw.
*Lentinus cochleatus Fr.
Lenzites betulina Fr.
L. vialis Pk.
Lycoperdon pyriforme Schaeff
Marasmius rotula Fr.
Merulius corium Fr.
M. fugax Fr.
M. rufus Pers.
M. terrestris (Pk.) Burt
M. tremellosus Schrad.
Mycena corticola Fr.
Odontia arguta (Fr.) Fr.
O. bugellensis Fr.
†O. castaneae B. & G.
*O. fimbriata (Pers.) Fr.
O. granulata Burt
O. hydnoides Schw.
O. nivea Karst.
O. trachytricha B. & C.
Omphalia campanella Fr.
Panus rudis Fr.
P. scutellatus Schw. ex Cooke
P. stipticus Fr.
Paxillus atrotomentosus Fr.
P. panuoides Fr.
*Peniophora allescheri Bres.
P. burtii Romell
P. cinerea (Pers.) Cooke
P. corticalis (Bull.) Bres.
P. cremea Bres.
P. filamentosa (B. & C.) Burt
P. incarnata (Pers.) Karst.
*P. maculaeformis Fr.
P. miniata (Berk.) Burt
P. pubera Fr.
†P. ravenelii Cooke
P. roumeguerii Bres.
P. setigera (Fr.) Bres. (forma grandinioides)
P. velutina (DC.–Fr.) Cke.
P. violaceo-livida (Sommf.)
Phlebia contorta Fr.
P. radiata Fr.
P. strigosozonata Schw.
*Pholiota adiposa Fr.
*P. squarrosa (Murr.) Karst.
Pleurotus ostreatus Fr.
Polyporus adustus Fr.
P. Berkeleyi Fr.
†P. castaneae B. & G.[19]
P. chioneus Fr.
P. cinnabarinus Fr.
P. crispus (P.) ex Fr.
P. frondosus Fr.
P. galactinus Berkeley
†P. giganteus (Pers.) Fr.
P. gilvus Schw. ex Fr.
P. glomeratus Pk.
P. nidulans Fr.
P. pilotae Schw.
P. pocula (Schw.) ex B. & C.
P. pubescens Fr.
P. semipileatus Pk.
P. spraguei B. & C.
P. spumeus Fr.
†P. squamosus Hud. ex Fr.
P. sulphureus Fr.
P. umbellatus Fr.
*Polystictoides biformis Klotzsch.
†P. castanicola Laz.
P. hirsutulus Schw.
P. hirsutus Fr.
†P. lewcomelas Laz.
P. pargamenus Fr.
†P. revolutus Bres.
P. versicolor Fr.
*Poria aurea Pk.?
P. cinerea (Schw.) Cooke?
†P. consobrina Bres.

[19] *Polyporus castaneae* has been listed by Weir (31) as a synonym for *P. spraguei*.

P. contigua Fr.
P. cremor Bk.[20]
*P. cruentata Mont.[20]
P. ferruginosa (Schrad.) Fr.
P. medulla-panis (Pers.) Cooke
P. mucida Fr.
P. mutans Pk.
P. mutans var. tenuis Pk.
P. punctata Fr.
P. purpurea (Hall) Cooke
P. semitincta (Pk.) Cooke
P. subacida Pk.
P. tenuis (Schw.) Cooke
P. viticola (Schw.) Cooke [21]
†P. vitrea Pers.
P. vulgaris Fr.
Porothelium fimbriatum Fr.
†Protomerulius javensis Burt
Schizophyllum commune Fr.
Sebacina deglubens?
†S. mesomorpha B. & G.
Steccherinum adustum (Schw.) Banker
Stereum abietinum (P.) ex Fr.
*S. albobadium (Schw.) Fr.
*S. chailletii Pers.
*S. erumpens Burt
S. fasciatum Schw.
*S. fuscum Schrad. ex Quél.
S. gausapatum Fr.
S. hirsutum Willdenow ex Fr.
S. lobatum (Kunze) Fr.
S. ochraceo-flavum Schw.
S. purpureum Pers.
S. rameale Schw.
S. roseo-carneum (Schw.) Fr.
*S. rugosum Pers.
S. sericeum Schw.
S. subpileatum B. & C.
S. umbrinum B. & C.
S. versiforme B. & C.
Thelephora terrestris Ehrh. ex Fr.
†Tomentella (Hypochnus) castanea B. & G.
Trametes dependens (B. & C.) Baxter
T. sepium Berk.
*Tremella mesenterica Retz.
†Trogia crispa Fr.
*Volvaria bombycina Schaeff

Office of Forest Pathology
United States Department of Agriculture

[20] Plant imperfectly understood.

[21] Probably the names *Poria contigua* Fr. and *P. viticola* (Schw.) Cooke represent the same fungus.

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PLATE XXXII

Decay in chestnut caused by *Polystictus pergamenus*. The sapwood is soon infected after the trees have been killed by the blight. The decayed spots enlarge and completely surround the blight-cankered areas. Note such an area which is not decayed. Photograph by Edward Littlefield and D. V. Baxter. New York State

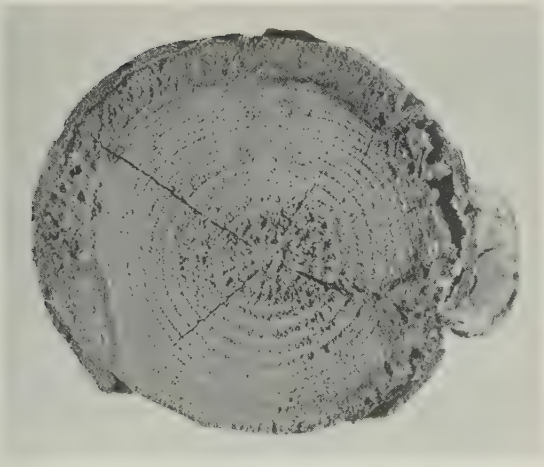
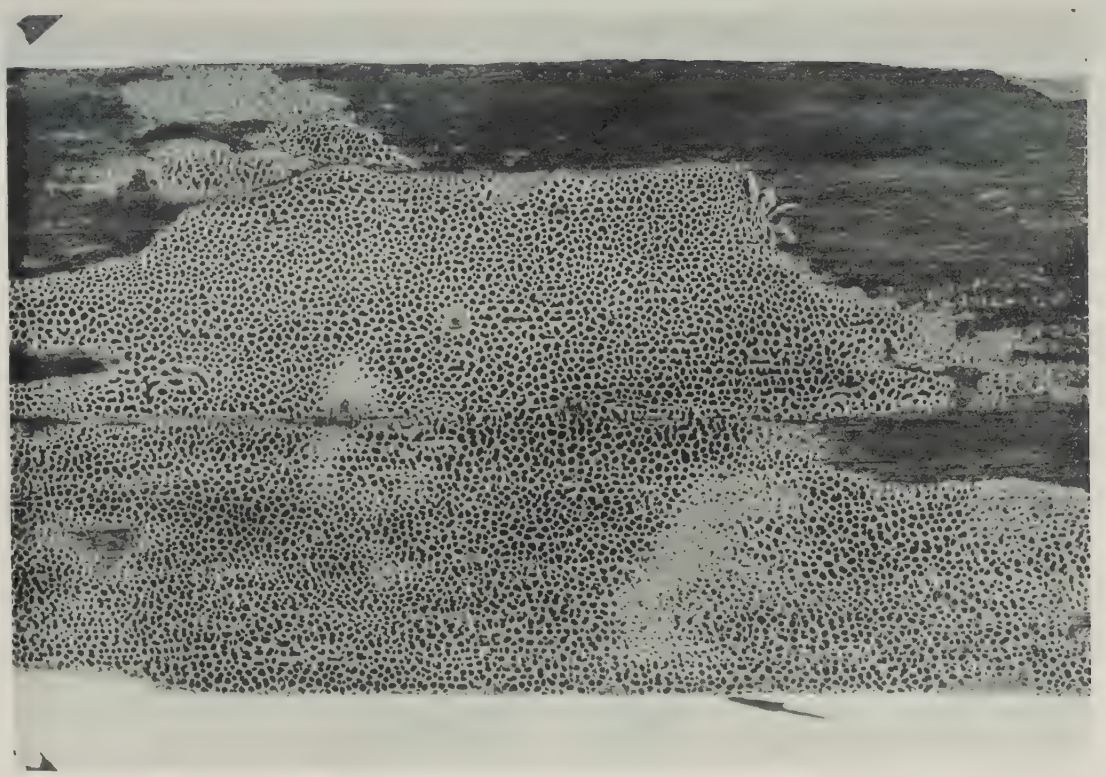


FIG. 1. *Polyporus gilvus* on chestnut. Note that the decay does not extend all around the circumference of the limb. The blight-cankered area appears on the lower side

FIG. 2. *Armillaria mellea* Fr. Rhizomorphs which appear beneath the outer bark of the dead chestnut



Trametes sepium Berkeley

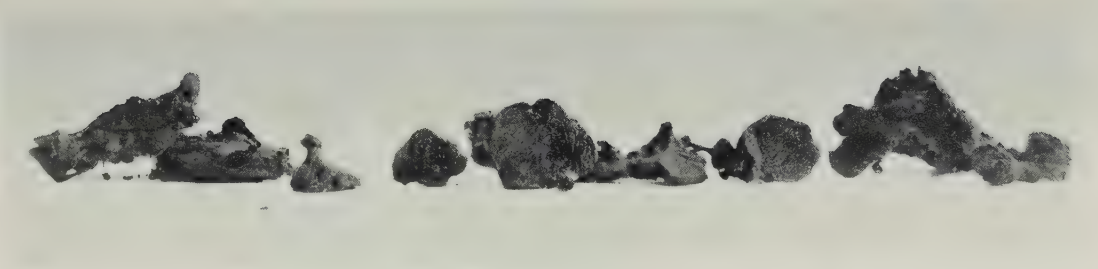


FIG. 1

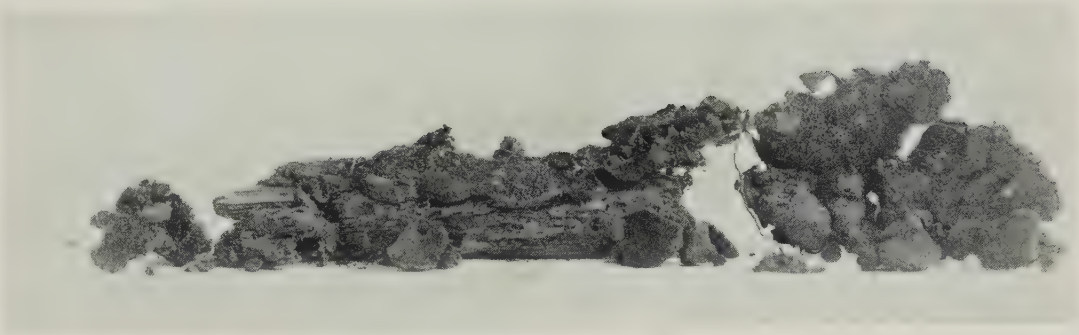
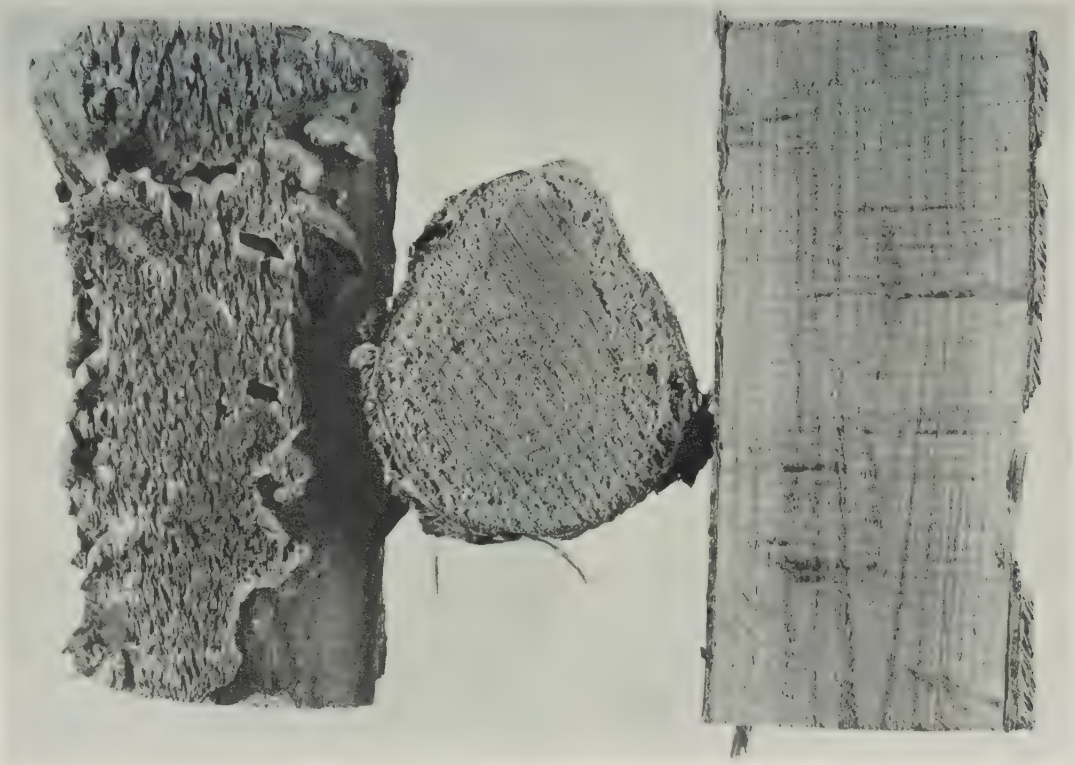


FIG. 2

FIGS. 1-2. *Trametes dependens* (B. & C.) Baxter. Black Mountain, North Carolina. This very rare fungus grows pendent and hangs on the under side of fallen chestnut débris. It has been reported on pine in the literature



Irpex tulipifera on chestnut sprouts

PLATE XXXVII

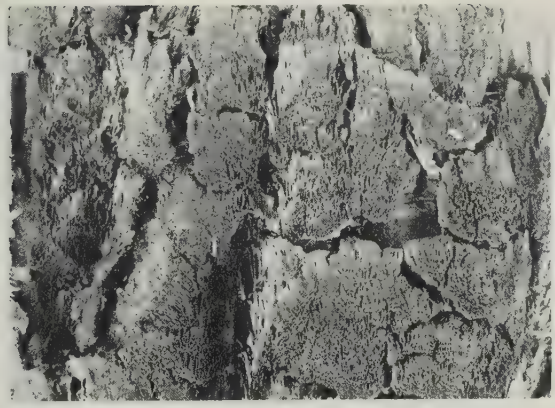
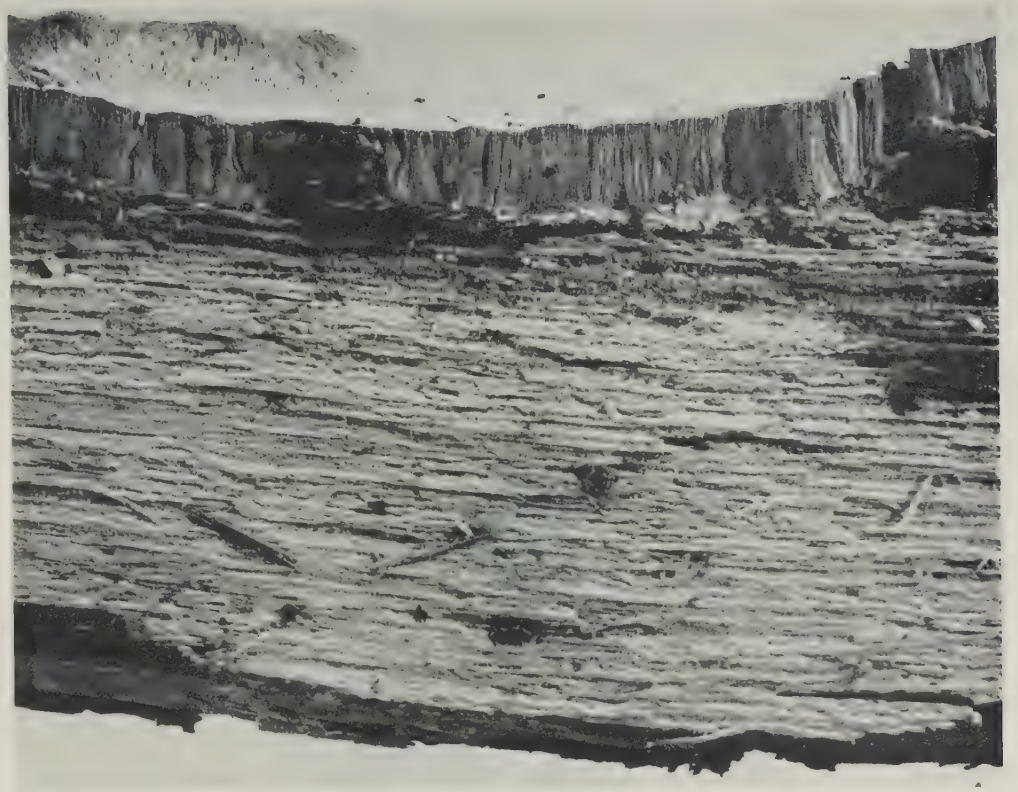


FIG. 1. *Poria subacida* Pk. on chestnut

FIG. 2. Decay produced in chestnut by *Poria subacida* Pk. Note mass of mycelium in lower figure



Poria mutans Pk. is associated with a pocketed rot of chestnut

FIG. 1. Decay in a large chestnut sprout produced by *Poria ferruginosa* (Schrad.) Fr., which is one of the common porias found on chestnut

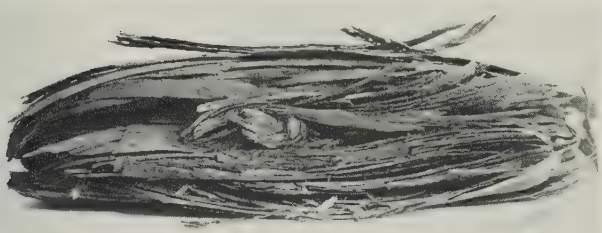


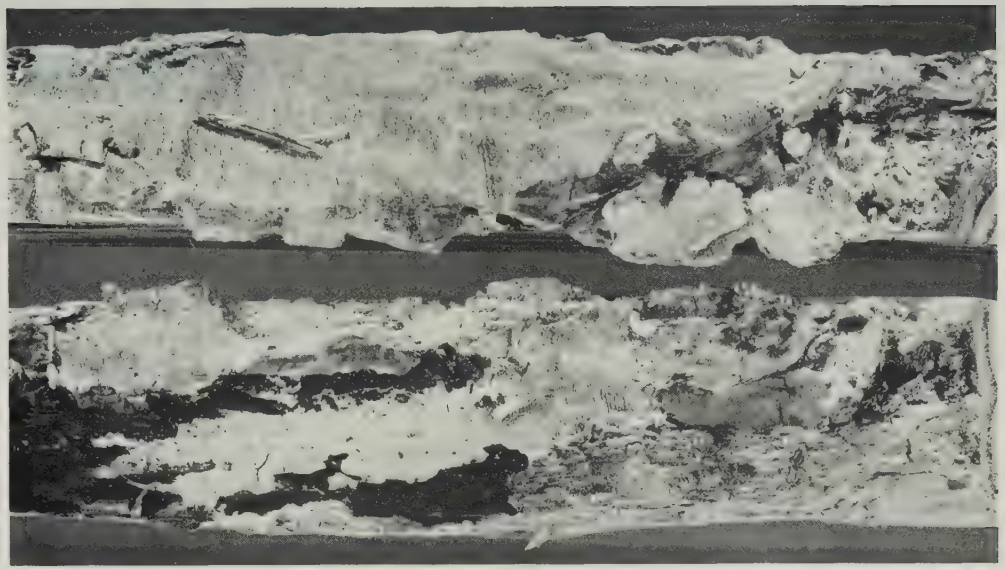
FIG. 2. Badly decayed chestnut wood on which *Poria mutans* was found. This wood is in the last stages of disintegration

FIG. 1. *Poria mucida* Pers. Specimen from Buena Vista, Virginia, on chestnut extract log. Plant det. H. Bourdot. Compare the sinuose structure illustrated in this photograph with that of *Poria sinuosa* Fr., Figure 2

FIG. 2. *Poria mucida* on chestnut extract wood. Note the hydnoid-like structure and the contrast between this specimen and the one shown in Figure 1

FIG. 3. *Poria sinuosa* Fr. on log of *Abies balsamea*

PLATE XLI



Poria tenuis Schw. on chestnut. Note the leathery appearance of the plant, the wide fungous margin which ramifies over the bark and leaves. The evidence of the cracking-up of the hymenium in this plant is not so conspicuous as it is in *Poria medulla-panis*

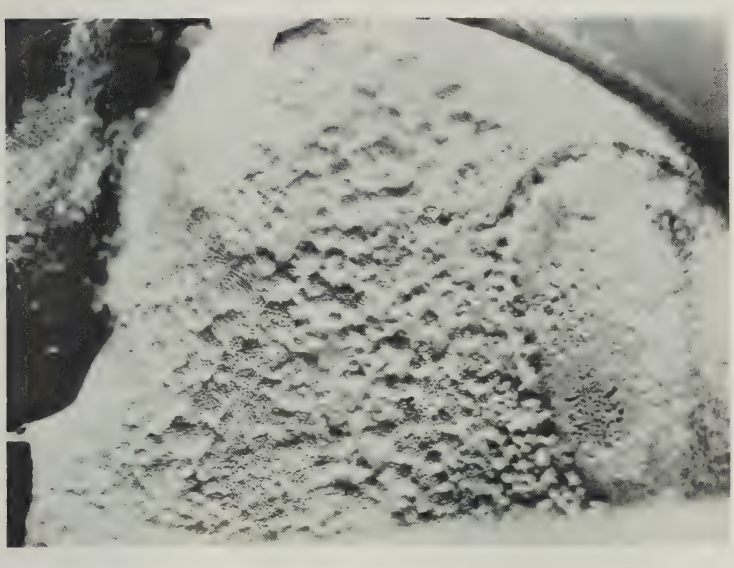


FIG. 1. *Poria medulla-panis* in culture. Subculture from plant grown in cold room at 12° for eight months. This plant grown in the laboratory at room temperature. No fruit formation has been noticed in cultures of *Poria tenuis* Schw.

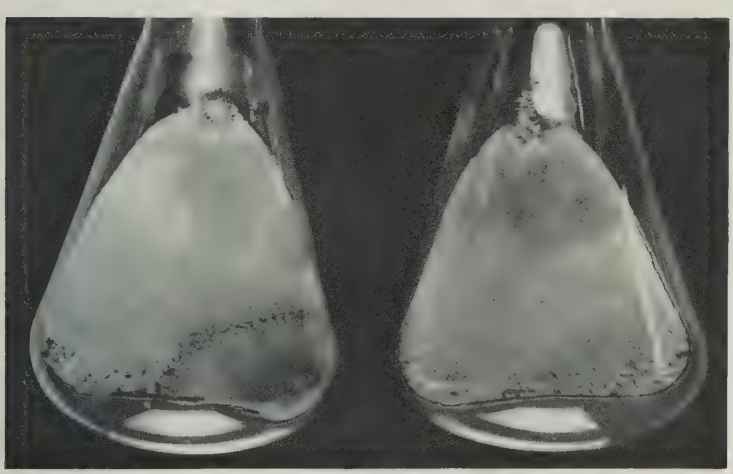


FIG. 2. *Poria tenuis* Schw. Note the rhizomorph-like strands of mycelium which appear on the inoculum. Such strands are characteristic of this fungus. *Poria medulla-panis*, a closely allied plant, has not produced such strands in culture

FIG. 1. *Daedalea quercina* Fr. on chestnut stump

FIG. 2. *Polyporus spraguei*, one of the most important timber destroyers of chestnut. Fruiting-body on end of log cut for mill on area studied for heart rots in the Great Smoky Mountains of Tennessee

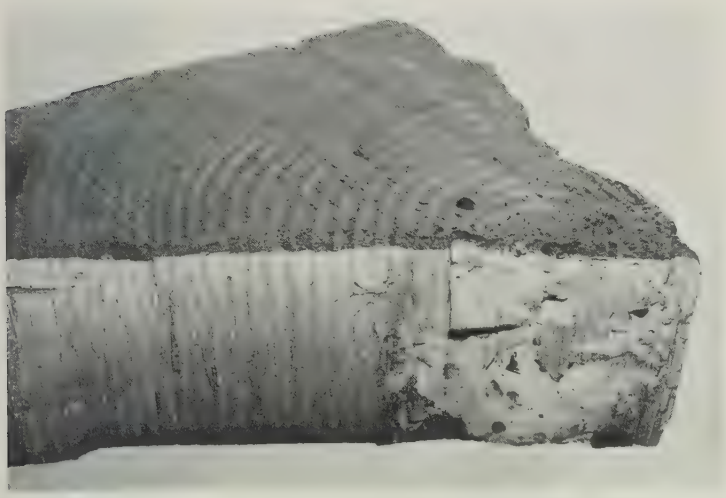


FIG. 1. Decay in chestnut wood from girdled area, caused by *Polyporus spraguei*

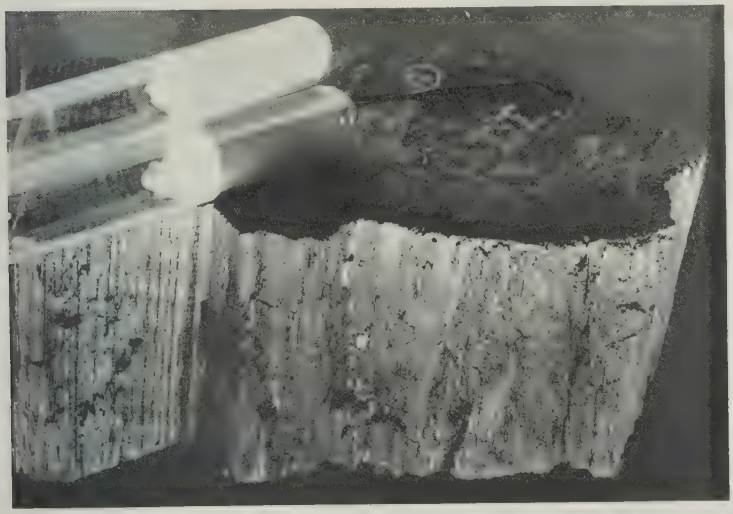


FIG. 2. Decay in chestnut wood from girdled tree, caused by *Polyporus spraguei*

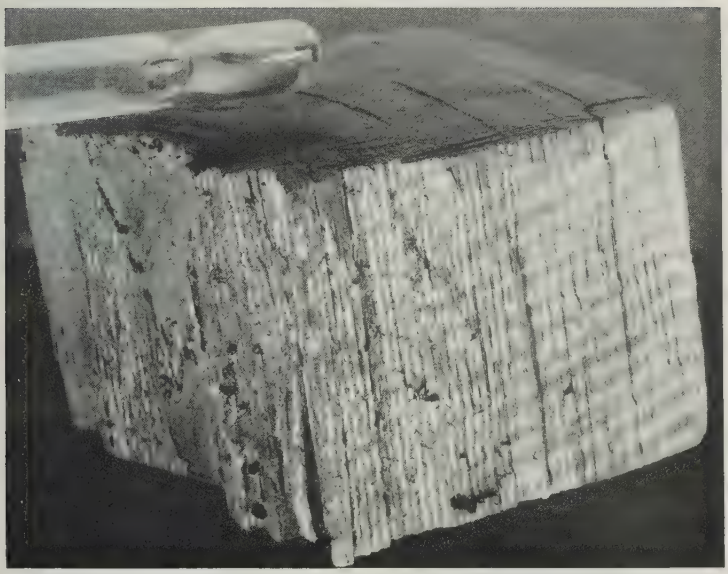


FIG. 1. *Polyporus pilotae* on chestnut and a culture of it. Specimen collected from dead chestnut which had been girdled

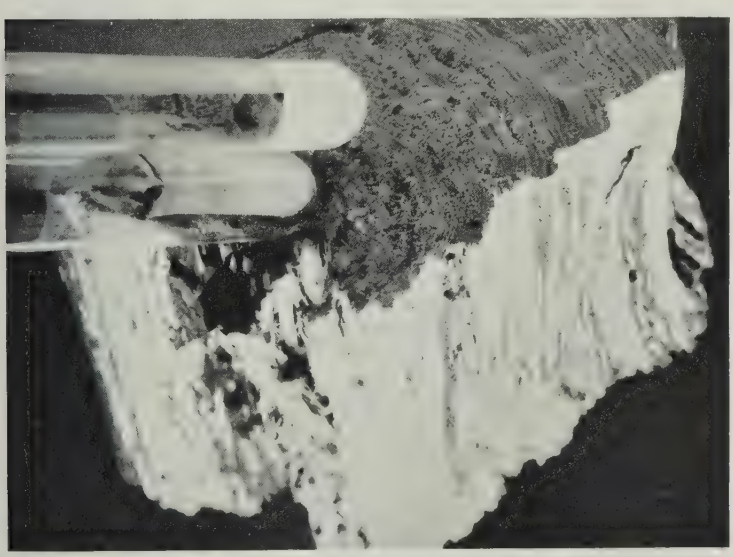


FIG. 2. *Polyporus pilotae* on chestnut and an advanced stage of rot

FIG. 1. *Fistulina hepatica* at base of fire-killed chestnut tree

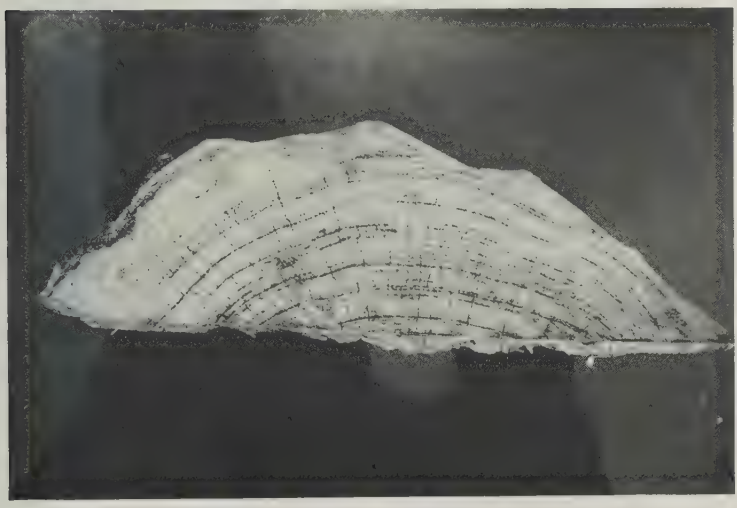


FIG. 2 Darkened areas which accompany the fruiting-bodies of *Fistulina hepatica* Fr. on chestnut

PLATE XLVII

Polyporus sulphureus Fr. on standing telephone pole. Fruiting-body five feet from the ground. Photograph by R. P. Marshall

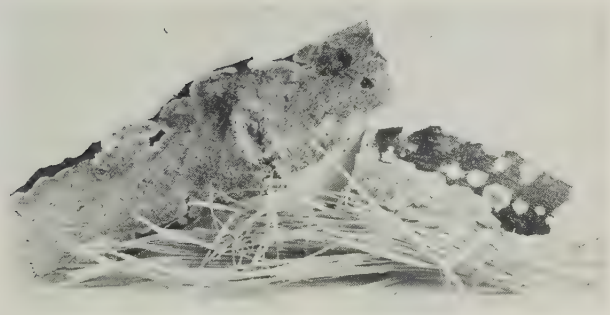


FIG. 1. *Corticium scutellare* B. &. C. on dead limb of chestnut

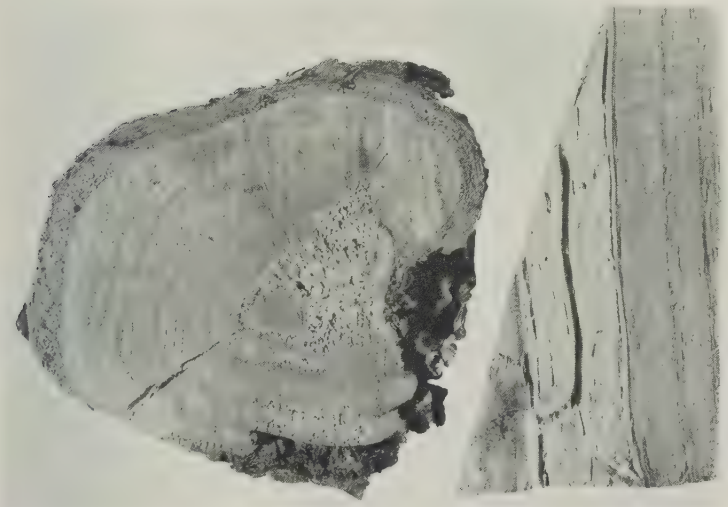


FIG. 2. Heartwood and sapwood decay of *Castanea mollissima* caused by *Stereum gausapatum*. Injury originally caused by blight which served as an inoculation point for the fungus

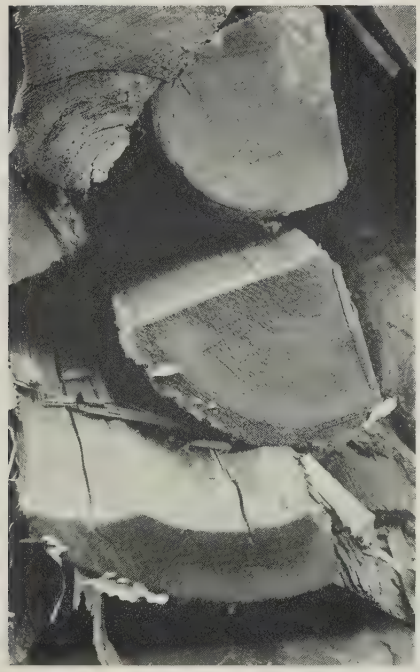


FIG. 1. *Schizophyllum commune* and *Stereum ochraceo-flavum* on chestnut extract logs. North Carolina

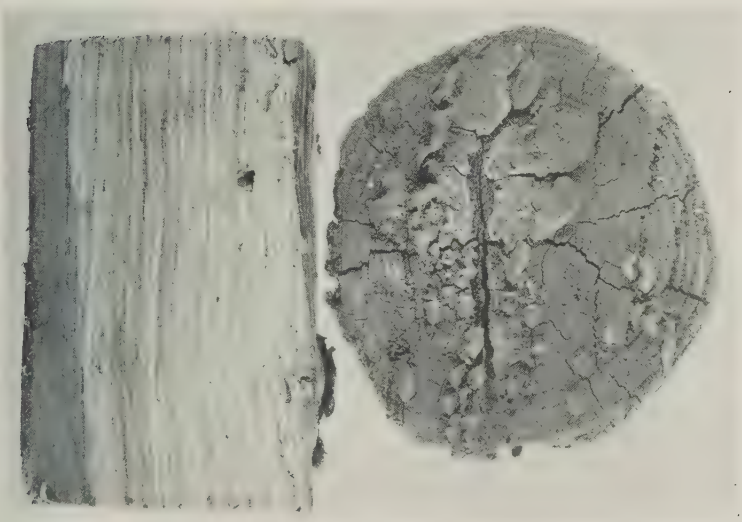


FIG. 2. *Hymenochaete rubiginosa* and partially decayed chestnut log. Fruiting-bodies of *Hymenochaete rubiginosa* make their appearance on decorticated wood

A PROGRESS REPORT ON THE DIFFERENCES IN GROWTH OF SPRUCE AND PINE ON POOR SOIL

LEIGH J. YOUNG

IN 1919 a report was made upon the differences in the height growth of Norway spruce and three species of pine that had been planted on areas on which the previous growth of the spruce had been very poor.[1] A description of the areas concerned and various other details which were given in that report will not be repeated here.

The object of the experiment was to determine whether the pines could make better growth than the spruce on these areas and how the pines compared with one another in their ability to do this.

The growth data published in 1919 are given in Table I.

TABLE I

COMPARATIVE TOTAL HEIGHT GROWTH TO 1919

Species	Total height in feet		
	Maximum	Minimum	Average
Norway spruce	7.0	0.9	2.88
White pine	3.1	0.4	1.3
Scotch pine	5.1	2.2	3.8
Western yellow pine	2.0	0.5	1.1

The mean annual height growth up to 1919 of the several species from the time of the germination of the seed is given in Table II.

[1] Young, L. J., "A Study in the Difference in Soil Requirements of Pine and Spruce," *Ann. Rep. Mich. Acad. Sci.*, 21 : 219–221.

TABLE II

Mean Annual Height Growth to 1919

Species	Mean annual height growth in feet
Norway spruce	0.17
White pine	0.16
Western yellow pine	0.18
Scotch pine	0.54

The trees on the plots were remeasured in the fall of 1925 and the fall of 1928. In 1928 the age of the spruce since planting was 25 years; that of the pines, 14 years. The total age of the different species from the time of the germination of the seed was for Norway spruce 27 years, white pine 18 years, western yellow pine 16 years and Scotch pine 17 years.

The results of the 1928 measurements are given in Table III below.

TABLE III

Comparative Total Height Growth to 1928

Species	Total height in feet		
	Maximum	Minimum	Average
Norway spruce	23.7	1.7	10.9
Western yellow pine	15.9	3.7	10.7
White pine	21.6	3.9	12.2
Scotch pine	25.8	18.6	22.8

In spite of the considerable difference in age, the average height of white pine and Scotch pine exceeds that of spruce, and the average height of western yellow pine is nearly equal to that of spruce. All the pines are above spruce in minimum height, and the range in height of the Scotch pine is shown to be unusually small. Ap-

parently, Scotch pine is not so sensitive as the other species to variations in soil conditions.

The average figures in Tables I and III form the basis for computing the values given in Table IV.

TABLE IV

MEAN ANNUAL HEIGHT GROWTH TO 1928

Species	Mean annual height growth in feet		
	Since planting (A)	Since germination of seed (B)	Spring, 1919—fall, 1925 (7 years) (C)
Norway spruce	0.43	0.40	0.76
Western yellow pine	0.76	0.67	0.93
White pine	0.87	0.68	0.93
Scotch pine	1.63	1.34	1.96

The figures in columns B and C of this table furnish a fairer basis for comparing the growth of the various species than those in column A. However, all the figures show the marked superiority of Scotch pine in the ability to utilize a low-grade soil. During the seven-year period the growth of western yellow pine has been equal to that of white pine, and the difference between the growth of Scotch pine and that of the other pines has become much greater than in 1919. The mean figures for all of the species, as given in columns B and C, show a very notable increase over the corresponding figures given in Table II. Moreover, the figures for spruce do not bear out the prophecy, made in 1919, to the effect that the rate of growth of the spruce might be expected to decrease still farther. This statement was based upon the generally unhealthy appearance of most of the spruce at that time and a reasonable doubt as to their ability to recover from the stunting that they had received.

As soil conditions have gradually improved, the recovery of the spruce has been apparent to any observer without resorting to measurements to prove it. Not only has height growth increased, but the color of the foliage has become deeper to a marked degree.

The improvement in soil conditions has doubtless been due largely to lessened evaporation of soil moisture as the crowns of the trees have widened, and to a lesser degree to the increase in organic matter. There may also have been some increase in the available amount of mineral elements, due to changed conditions of leaching and weathering.

The behavior of the spruce is a definite indication that important changes have occurred as the result of the cessation of cultivation, the elimination of run-off and erosion and the establishment of a forest cover.

From the 1925 measurements the mean annual height growth in feet for the last three years has been found to be 0.90 for Norway spruce, 1.03 for western yellow pine, 1.47 for white pine and 1.77 for Scotch pine. Reference to column C, Table IV, shows that all the species, except Scotch pine, had a higher mean growth during the last three years than during the preceding seven years. White pine now ranks second and approaches Scotch pine more closely than at any previous period. The growth rates of spruce and western yellow pine are now closer together than during the preceding seven-year period.

The decline in the rate of Scotch pine raises the question whether such a decline is normal and to be expected, at a corresponding age in all cases. An answer was sought by computing the mean growth by periods for three different stands of Scotch pine, located on other portions of the Saginaw Forest.

The results of these computations are given in Table V.

TABLE V

Mean Annual Height Growth of Scotch Pine by Periods

Stand	Period in years of total age				
	0–13	13–17	13–18	17–22	18–23
1. Unthinned.....	1.52	1.45	....	1.78	....
2. Thinned.....	1.57	1.75	....	1.98	....
3. Thinned.....	1.55	....	1.76	....	1.66

The foregoing figures do not indicate that a decrease in mean annual growth is to be expected at any given age in all cases. Stand 2 shows a steady increase up to the age of 22 years. Stand 1 suffered a small but temporary decrease from thirteen to seventeen years. And Stand 3 did not decrease until some time after 18 years. Later measurements may show this to be temporary, as in the case of Stand 1. Schlich's [2] yield table for Scotch pine shows a permanent decrease in the mean growth after thirty years, but not earlier. From the evidence cited, it would appear that the decrease in the case of the Scotch pine on the spruce area is more likely to prove temporary than it is to be permanent.

CONCLUSIONS

Norway spruce, once established, is tenacious of life on an unfavorable soil and is able to recover from a stunted condition, if soil conditions improve.

Scotch pine, white pine and western yellow pine are less exacting in their soil requirements than spruce, as indicated by the better growth attained. However, this is most true of Scotch pine, with white pine second.

At present, the differences in the rates of growth of the several species are less than in the earlier years.

UNIVERSITY OF MICHIGAN

[2] Schlich, Sir Wm., *Manual of Forestry*, Fifth ed., 3 : 357.

THE DISTRIBUTION OF POPULATION IN NORTHERN NIGERIA

STANLEY D. DODGE

A RECENT publication [1] makes it possible to construct a map showing the distribution of population in Northern Nigeria. It contains a census by tribal areas and a map of these areas, so that it is possible to distribute the data with a fair degree of accuracy. Reinforced by knowledge gained from the literature on Northern Nigeria, the distribution of the data on the tribal map as a base does not involve, in all probability, errors of any great magnitude.

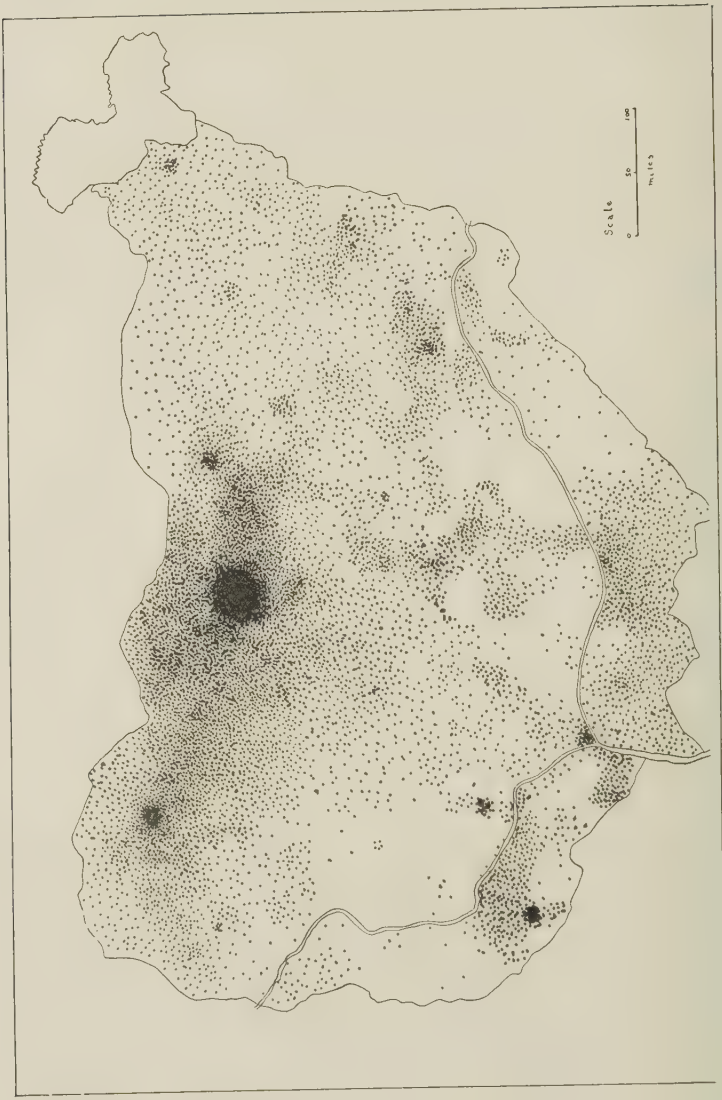
Most of the people of Northern Nigeria are clustered in the center of the northern part of the area (Map 4). Southward and eastward, the population thins out into scattered settlements that are variously distributed. Large areas remain practically unoccupied. The arrangement of population in the whole of Northern Nigeria, irregular as it is, is related closely to the distribution of the several other elements that make up the geography of that region.

More than half the people of Northern Nigeria are concentrated in and about Kano. The central town has developed at the base of a commanding hill in an otherwise almost featureless plain.[2] Grouped about it there are many smaller towns and villages. These are the dwelling places of the agricultural peoples, who find an outlet for much of their produce in the city of Kano. Farther out from Kano the smaller villages are more and more scattered and merge finally with the villages of the nomadic and semi-nomadic tribes that occupy much of the plain.

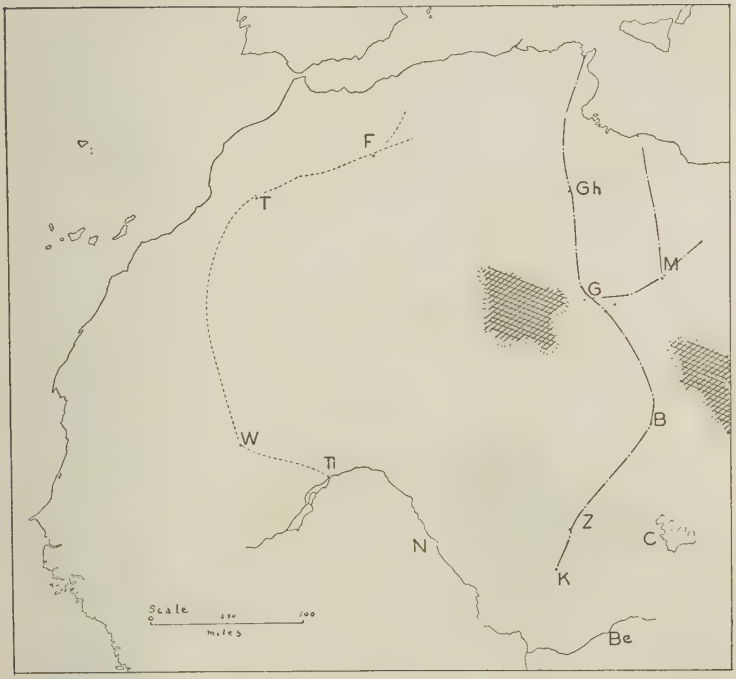
Kano owes its preëminence in population numbers to trade.

[1] Meek, C. K., *The Northern Tribes of Nigeria*, London, 1925.

[2] Barth, H., *Travels and Discoveries in North and Central Africa* (New York, 1859), 1: 495–496.



Map 4. Distribution of population in Northern Nigeria. Each dot represents 1,000 people



Map 5. Trade routes of the Sahara in relation to Northern Nigeria. The western route is the old route, now little used; the eastern route is the main trans-Saharan trade route. Cross-lined areas represent approximately the distribution of highland. *B* stands for Bilma Oasis; *Be*, Benue River; *C*, Lake Chad; *F*, Figig; *G*, Ghat; *Gh*, Ghadames; *K*, Kano; *M*, Murzuk; *N*, Niger River; *T*, Tafilelt; *W*, Walata; and *Z*, Zinder. The area studied lies between the Niger and the Benue, eastward to Lake Chad; the northern boundary lies between Kano and Zinder.

The trade situation of Kano is dependent on the routes across the Sahara. From the fertile areas of the region of summer rains that we call the Sudan to the Mediterranean littoral only a small number of oasis routes are at present available for trans-Saharan travel. North of Kano lies Zinder (Map 5). From this town in the very edge of the desert the main trade route runs northeastward to Bilma. From the Bilma oasis the route crosses the western, lower

part of the Tibesti Mountains to Ghat and Murzuk, whence the Tripolitan ports are reached directly. Tunis and Algiers are reached from Murzuk and Ghat through Ghadames. Other connections from Bilma run southward to Ft. Lamy or Kukawa, utilizing them as southern termini in place of Zinder. Farther west the trans-Saharan routes are now practically unused.

Kano rose to its present position late in the history of the Western Sudan.[3] Before the spread of Islam westward along the Mediterranean and the establishment of Moslem contacts with the Western Sudan, the principal trade route came from the north through the western part of the Sahara. Walata, northwest of Timbuktu (Map 5), was the terminus. With the shifting of political and economic fortunes in the Western Sudan and Sahara, with the successive rise and fall of various political entities, towns more and more toward the east rose to prominence. At the time of the entrance of the British into Nigeria, the town of Kano was at the head of economic affairs in the area. The British used it as a trade headquarters and subsequently built a railway to it. Thus its preëminence is temporarily assured.

In order to understand the distribution of population in Northern Nigeria, it will be necessary to consider the differences between the two major natural regions in which it is divided. The northernmost part of the area, with Kano as a center, is an almost featureless plain; the southern part, the highland of Bauchi, is a plateau with considerable relief. Bauchi is cut by many deep valleys; above the general level of the plateau rise numerous erosion remnants. Many parts of the area are conspicuously rugged. The plain, where uncultivated, is covered with acacia-tall grass savanna, which is characteristic of the transition from the humid forested Nigerian coast to the dry wastes of the Sahara.[4] Bauchi bears the more luxuriant grass and the low trees of the more humid regions nearer the ocean. Hill tops in both parts are characterized by dry forests.

[3] Lugard, Flora Shaw (Lady), *A Tropical Dependency* (London, 1905), pp. 100–218, *passim.*

[4] Shantz and Marbut, *Vegetation and Soils of Africa* (New York, 1923), map.

The highland of Bauchi is inhabited by many tribes and by but few people, whereas the plain has few tribes and many people. The name Bauchi signifies "slaves," and refers to the practice of capturing the highland people for service on the plain or for sale beyond the Sahara. After the discovery of the sea route to the Guinea Coast, the sale was made frequently to sea captains, who took the slaves to the newly developed plantations in the Caribbean and North America. The people of the plain would be classed as civilized. They have a town economy, wear clothing, and have elaborately developed governments. On the other hand, the people of Bauchi, oppressed as they have been always, remain, in a sense, backward. They have a minimum of clothing, lack a well-developed town organization, and are, for the most part, pagan rather than Moslem. They have always seemed inferior to the people of the plain.

In the political developments of the plain of Northern Nigeria, Kukawa, the capital of Bornu, has had a history similar to that of the towns of the west. From time to time it has reached a peak of power and declined as rapidly in importance. When the British reached Nigeria they found Kukawa in a state of economic depression. This has resulted in loss of trade which contributed in part to the sparseness of population in the eastern part of the plain. Environmental differences are more important in explanation of the lower population density of the province of Bornu, as contrasted with the rest of the plain. The climate is somewhat drier, rendering agriculture less secure; the people are primarily nomadic herdsmen. The land itself is largely the dry bottom of a diminished Lake Chad. There are relatively few arable spots. The soil is very sandy.[5] This area is characterized by Shantz and Marbut, in their *Vegetation and Soils of Africa*, as grazing land of very low productivity.

The people of Bauchi are scattered in small groups over the relatively uneven surface of their plateau. The high, inaccessible ridges, with dry forest and deep valleys, with tropical rain forest, preclude the settlement by any large numbers of people of portions of the plateau. The exigencies of intertribal warfare and of slave

[5] Shantz and Marbut, *op. cit.*

raids have reduced the numbers of people, and the remnants dwell in a kind of inherited fear and in mutual hostility.

The scattered villages of Bauchi are especially numerous in the areas of fertile soil and at significant trade centers. In pockets here and there in the plateau, areas of colluvial soil have attracted greater numbers of people because of the possibility of agriculture. In some of these areas terraces have been built on the lower slopes of the hills, increasing the agricultural area and testifying to the relative density of population.[6]

Bauchi Plateau is threaded by a maze of trade routes, along which the Fulani traders of the plain plied with caravans of goods and slaves, and in the trading towns of which they have settled, as the Chinese have in similar situations in Java and the Jews and Greeks in the commercial centers of Anatolia. Most of the more densely populated areas of the plateau are such trade centers with their surrounding agricultural lands. Some of the highways have been improved; one, at least, has a railway alongside it.[7] Throughout the area occupied and served by this route, there are many clusters of towns and villages and a density of population high for the plateau. The other centers and areas of dense population correspond to the principal Bauchi trade routes.

Throughout Northern Nigeria routes of trade have been responsible in large part for the distribution of population in the area. From the termini of the trans-Saharan routes in the north to the villages along the Benue in the south people have congregated where there is an opportunity for trade. Above all, Kano, the emporium of the plain between Chad and the Niger, between the highland of Bauchi and the Sahara, has become and remains the center of greatest density of population in Northern Nigeria. Historically, it rose late to preëminence among the cities of the Western Sudan.

[6] Meek, C. K., *op. cit.*, 1 : 121–132.

[7] The maps differ as to the status of the railway that crosses Bauchi. Some show a branch running from the north and another coming from the south, ending south of the Benue. Others represent the railway as in the process of construction, connecting the termini of the railways in the class mentioned above. Still others, notably Meek's, show the railway as actually in use for the whole distance. Nearly all maps disagree about its actual location. The general route from north to south, however, remains an important highway.

In the twentieth century it has crystallized, temporarily at least, as the center of trade under the influence of the Nigerian Railway.

The character of the trade of Northern Nigeria has contributed to the present distribution of population. Gold, ivory, leather, ostrich plumes and slaves made up the bulk of the commodities transported across the desert.[8] The capture and sale of slaves, of whom vast numbers were dispatched annually to the Mediterranean littoral,[9] reduced the population of Bauchi to the remnants of numerous refugee tribes, while it increased the population of the plain, where many slaves were retained for domestic and field labor. Nor has the more lenient system of enforced labor under the British been sufficient to reëstablish a numerous population for the plateau.

Apparently the fact that Kano is the railway terminus holds it as the center of population distribution. When the line is extended northward to Zinder, or eastward to Kukawa, it is probable that these towns will grow in population to equal or surpass Kano, except that Zinder is located farther in the wastes of the desert and Kukawa has for its local support only the infertile plain of Bornu, of which it is the capital. However, the extension and multiplication of railways will bring readjustments in the distribution of population, but apparently the disparity in numbers of people between the highland of Bauchi and the plain of Northern Nigeria and between the sandy east and fertile west of that plain will persist.

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[8] Lugard, *loc. cit.* [9] Meek, *op. cit.*, 1 : 287.

ROAD PATTERNS OF THE SOUTHERN PENINSULA OF MICHIGAN *

ARTHUR FIELD

IN GENERAL, two major types of road patterns may be recognized. The first is the natural type, developed naïvely by man or animals as a compromise between the most direct route from one place to another and the most expedient route. The second is the artificial type, created and applied by man irrespective of conditions of the fundament. The natural pattern developed in an area may be interrupted by a superimposed artificial pattern, as, for example, the rectangular pattern of the Middle West of the United States. In the long run, however, except in urban areas, the natural patterns tend to dominate the artificial ones. In hilly or mountainous lands, also, the artificial plans have less chance for development. Whatever the pattern may be, it cannot be fully understood unless it is considered in relation to the character of the terrain on which it lies.

GENERAL PATTERN OF SURFACE FEATURES OF SOUTHERN MICHIGAN

The surface features of the state of Michigan owe their origin primarily to the fluctuating movements of the ice cover in glacial times. In the Southern Peninsula of Michigan and in northern Indiana there were three main directions of ice movement, as evidenced in the southward lobate extensions of the continental ice-sheet (Map 6). The names of these lobes correspond to the present names of the penetrating arms of the Great Lakes, which occupy the same depressions as did the ice-lobes in their southward

* Paper from the Department of Geography of the University of Michigan, prepared under the direction of Professor Preston E. James. For information regarding the Indian trails, the author is indebted to Dr. W. B. Hinsdale of the University of Michigan.

Map 6. Moraines and chief rivers of the Southern Peninsula; also locations of type maps 8–12 (numbered 4–8 on this map)

migration.[1] The focus of these lobes was in northwest Indiana; the Lake Michigan, the Saginaw and the Huron-Erie lobes have movements in southward, southwestward and westward directions, respectively. Since, however, the whole of the state of Michigan is an area of glacial deposition, it was the retreat of the ice-sheet which was the great surface-molding agent. The Saginaw lobe was the first to melt back and it retreated along its axis of general movement. A recess was thus formed between the Michigan and the Huron-Erie lobes; the Saginaw section retained its essentially lobate contour through the formation of reëntrant angles. Frequent pauses in the retreat of the ice along this line led to the forming of morainic belts in harmony with the configurations of the three lobes. The distance between the concentric moraines varies from less than a mile to ten miles, the intervening plains being composed chiefly of sand and gravel outwash material. Periodic oscillations in the general retrogression caused the emphasis of some of the morainic belts and the weakening of others.

The retreat of the ice cover north of the southern water-parting of the Great Lakes drainage basin occasioned the formation of ice-dammed lakes, small at first, but later increasing in size. Lake Chicago, at the end of the Michigan lobe, Lake Saginaw at the end of the Saginaw lobe, and Lake Whittlesey at the end of the Huron-Erie lobe were formed in this manner; the last two united to form Lake Warren at a later stage. The drainage from Lake Warren to Lake Chicago by the Imlay Outlet accounts for the present-day channel of the Grand and Maple rivers.

The continued northward recession of the ice front resulted in different levels of the surface of the glacial lakes. Therefore, the margins of the Southern Peninsula at the present time have a series of well-defined glacial lake plains. The best examples are in the southeast portion of the state and around Saginaw Bay. The lakes finally dropped to their present levels when their eastward outlets through Niagara and the St. Lawrence were uncovered.

The depth and continuity of the deposits have given a uniformity to the landscape of the state. Conspicuous elevations and rugged

[1] Leverett, F., and Taylor, F. B., *The Pleistocene of Indiana and Michigan, and the History of the Great Lakes, U. S. Geol. Surv.*, 1915.

profiles are notably absent. Rock outcrops at a few places along the present lake shores and in Hillsdale, Jackson, Presque Isle and Alpena counties, but nowhere has it any marked effects on the land forms. Five main areas of plain may be distinguished. The old lake plain in the southeast is formed in a series of steps representing the different levels of the successive glacial lakes. This plain tapers from about thirty miles in width in the south to a few miles in width in the neighborhood of Port Huron. The second plain was formed by glacial Lake Saginaw and its successors. It is separated from the previous plain by a rather complex morainic system formed in the reëntrant between the Saginaw and the Huron-Erie lobes. The subparallel moraines, which border the Saginaw glacial lake plain in the northwest, provide the southeastern boundary for an extensive area of ground moraine and glacial outwash plains which extend as far north as Otsego, Montmorency and Oscoda counties. The moraines formed at the reentrant between the Saginaw and the Michigan lobes in Mecosta County separate the interior till and outwash plains from the fourth plain, which is composed of sandy lake deposits and has its maximum width of twenty miles where the Muskegon River flows across it to Lake Michigan. The fifth plain includes Kalamazoo, Cass and St. Joseph counties and was the outwash apron formed by the premature retreat of the Saginaw lobe.

Proving no exception to the general rule of recently glaciated areas, the surface drainage of the state varies greatly in its efficiency from one location to another. The majority of the surface streams are in the stage of early mature development in the normal erosion cycle, but with the irregular pattern typical of glaciated areas. Lakes occupying basins in the morainic belts or pits in some of the lowland areas of glacial outwash are present in every county except the three at the head of Saginaw Bay. Most of the shores of these lakes are marshy and bordered by belts of reeds, revealing the rapidity with which such depressions are filled by side-wash in a region of rainy climate and deep frosts (Dfb). Marshes occupy lake beds which have been partially filled and cover extensive areas of the old glacial lake plains and of the intermorainic belts.

The primitive cover was dominantly forest. A line from Mill Creek in St. Clair County to the water-parting between Pine and Maple rivers in Gratiot County and thence to the southwest corner of Berrien County forms approximately the northern boundary between the southern hardwood forests, chiefly oak and hickory, and the northern forests of mixed hardwoods and conifers, and pure stands of pine. The areas of these pure pine stands coincided, for the greater part, with the north-central sand and gravel plains. The distribution of cedar, balsam, tamarack and other swamp vegetation corresponded to that of the marshy tracts. Patches of prairie, nowhere of any great extent, obtained prominence in the southwestern part of the state. At the present day, owing to the destructive exploitation of its virgin stands during the latter part of the last century, the greater part of Michigan has a second-growth timber. In the southern half of the state the percentage of cleared land is higher than in the northern.

INDIAN TRAILS

The first marks of human travel to be engraved on the primitive landscape were the Indian trails. The arrangement of these trails resulted from the interplay of three factors: first, the desire for communication; second, modes of transportation; and, third, the character of the fundament, chiefly land forms, soil and natural cover. The latter set of factors has been discussed in the previous section.

The activities of the Indians fell into two main divisions, agriculture and hunting. The pursuit of the former resulted in the tendency to become sedentary, to form permanent villages. Settlements were formed near spots most favorable to agriculture, where a suitable combination of level land, fertile soil and abundant water might be had. The morainic ridges were unfavorable because of their infertility, the marshes because of their unhealthiness. Mouths of rivers were most commonly chosen as village sites. There was a village at the mouth of practically every river on the western shore of the state. There were also concentrations of villages around the sites of the present cities of Mackinaw, Saginaw, Detroit and Niles. Scattered villages were found in favorable

locations throughout the rest of the state. Maize cultivation was the dominant factor in the agricultural economy of the Indians, although there were other occupations. Better situation or greater industry might give to a village an increased ability to satisfy its needs. This created in neighbors a desire to raise their standard of living, either by barter or by the primitive but infinitely easier and simpler method, usurpation.

In hunting the Indian was necessarily governed by the habits of his prey. In their migratory movements deer and other wild animals tended to keep to definite routes. They avoided swamps, since their hoofs were unsuited for passage over soft ground. They traveled the lines of least resistance, as indicated by the river valleys and ridge crests. The hunter followed.

Tracks were developed, therefore, by the hunter pursuing his quarry and by the man seeking the products of his neighbor. These two agencies worked together; the same path frequently suited the needs of both and the casual trail became the recognized line of travel.

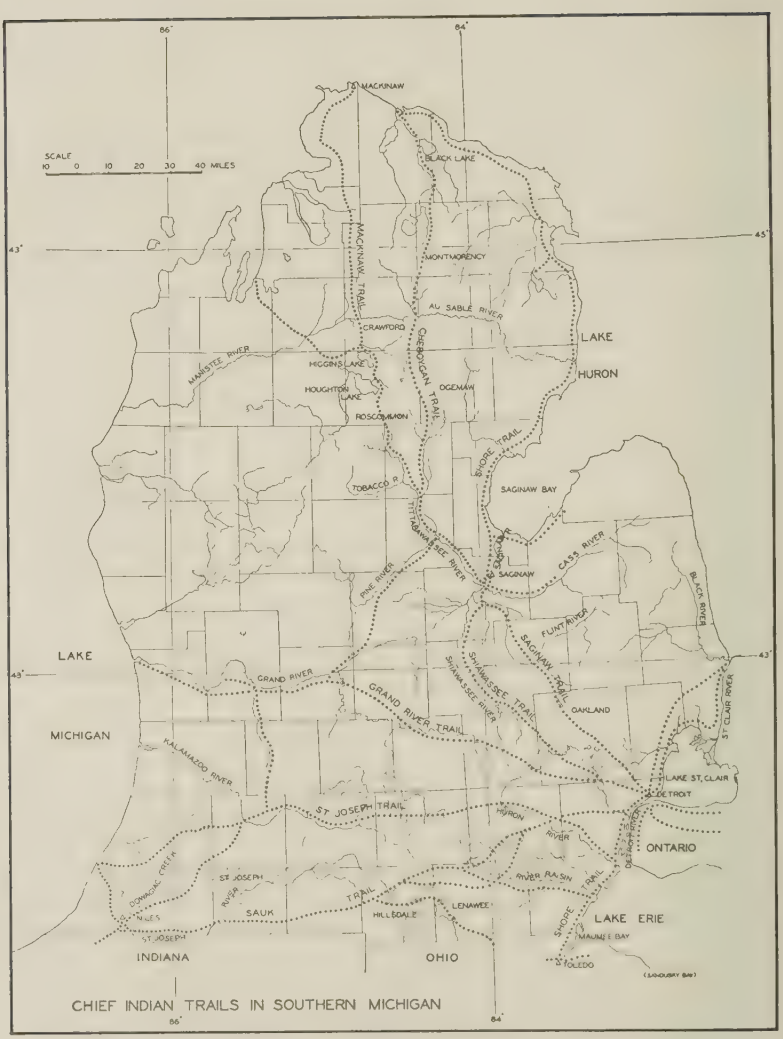
After the immediate needs of the group had been satisfied, the Indian, like other primitive beings, turned his attention to personal adornment. In the course of his wanderings, contact was made with neighboring groups, some new article was seen and immediately coveted, such as the copper of the Lake Superior district or sea shells from the tribes to the south. The elements of foreign trade became evident, and sometimes a medium of exchange was introduced, which usually had an apparent rather than a real value. The shells which came from the Gulf of Mexico probably are examples. Thus a system was evolved which was based on intercourse.

As regards means of travel, the Indian had but two, by foot and by canoe. Travel by land was the more important; even when he started by water, the Indian often had to go part of the way by land. In the months when the streams and lakes were ice-free long journeys were made by canoe, stream divides were crossed by portage, but the carrying of a light birch bark canoe imposed no great physical strain. In some months frozen streams necessitated recourse to land travel, thus accounting, in many places, for the

faithful adherence of some trails to river valleys, which at times provided water transport. Domestic animals as means of transport were introduced only after the spread of the white man's culture, which brought with it the horse and the wheel.

The interpretation of the Indian trail pattern rests on the distribution in the state of the nodal points of settlement, which were connected by the chief trails. In detail the trail pattern is modified by surface features. Thus in order to find main trend lines of travel it is necessary to determine first the major points of settlement, which were also points of external contact. There were three of these nodal points (Map 7), the districts around Detroit, Mackinaw and Niles. First is the Detroit location, at the westward apex of a triangular piece of land formed by Lakes Huron and Erie, which had a marked nodality, since trails from the St. Lawrence Valley and southern Lake Ontario converged at the northern end of the Detroit River. The second point, Mackinaw, is situated where the Straits of Mackinac are narrowest and facilitate passage to the copper region of the Upper Peninsula. The third point, Niles, is just to the northeast of the place where all lines of travel from north and east would converge in order to pass around the southern end of Lake Michigan. The concentration of routes at Niles on the St. Joseph River seems to be due to a favorable ford. Thus one would expect to find in the Southern Peninsula of Michigan an approximately triangular pattern of travel trend lines in Indian times, with modifications due to surface features.

The Southern Peninsula of Michigan was only a link in the great chain of travel which stretched westward across the nation from the Delaware and Chesapeake bays for over a thousand miles. This was the Great Trail. It joined the southern Shore Trail of Lake Erie at Sandusky Bay, from which, owing to the shifting boundary of the Black Swamp near Maumee Bay, it varied somewhat from one year to another, but eventually reached the site of Toledo. A trail which continued along the shore of Lake Erie, the Detroit River and the western shore of Lake St. Clair, led to a village at the junction of the St. Clair and Black rivers. From the Detroit junction an important route extended in a southwesterly



MAP 7. Chief Indian trails of the Southern Peninsula

direction, first over the flat lake plain and then as far as the northeastern part of Hillsdale County along the southern slopes of the dissected morainic ridge which forms the main water-parting between the rivers of western Lake Erie and the Kalamazoo and Grand River systems. From there, the southwest trend was preserved; the trail went across morainic country, interspersed with small outwash plains, as far as the southwestern part of St. Joseph County, where the St. Joseph River was encountered and used as a guide. This trail continued around the southern shore of Lake Michigan to the site of Chicago. It is called the Sauk Trail and formed part of the Great Trail system by means of a connecting route from north-central Lenawee County along the right bank of the River Raisin.

From the Detroit junction two trails branched in a northwesterly direction — the more westerly of the two being the Shiawassee Trail, which avoided the marshy interlobate reëntrant area of the northwestern part of Oakland County by keeping to the higher ground in the southwest of that county until the headwaters of the Shiawassee River were reached. Thence it became a valley trail, linking at Flint River with the more easterly of the two trails, called the Saginaw Trail. Crossing this river by the most convenient ford a single trail ran northwestward along the banks of the Saginaw River to its junction with the Cass River. From this point a trail ran northwestward along the Tittabawassee River, the direction of which is determined by the western edge of one of the later moraines of the retreating Saginaw lobe of the ice-sheet.

At the confluence of the Tobacco and Tittabawassee rivers the trail branched. The western arm, the Mackinaw Trail, followed the former river, then skirting the eastern shores of Houghton and Higgins lakes, continued in an almost straight line along the water divide of the Au Sable and Manistee rivers, making the Indian settlements on the Straits of Mackinac its objective. The eastern or Cheboygan Trail made great use of river valleys, following the Tittabawassee to its source in Ogemaw County, whence it continued across the outwash plains of the northeastern part of Roscommon County and the southeastern part of Crawford County to the

confluence of the North and South branches of the Au Sable River. Since it utilized a small left bank tributary of the North Branch to its source in the southwestern part of Montmorency County only about ten miles of undulating country had to be traversed before a tributary of the Black River was encountered. This valley the trail followed to the Black Lake and thence to the Indian settlements at the mouth of the Cheboygan River. At this point connection was established with the Shore Trail which had conformed in its pattern to the outline of the eastern shore of the state from Saginaw Bay.

From the junction of the Pine and Tittabawassee rivers easy communication could be made with the western shore by means of the Imlay Outlet. The Pine River flows east in the eastern part of this trough and is separated in its upper course from the Maple River only by a low divide in the valley of the glacial drainage line. The Maple River is a right-bank tributary of the Grand River, which was followed throughout its lower and middle course by a trail of similar name, which had for its objective the district now occupied by Detroit. Although there was a marked converging of routes at the northern end of the Detroit River, this was not the area in which there was the greatest concentration of Indian villages. This occurred at the meeting place of the St. Joseph River and Dowagiac Creek. Communications were maintained with the head of the Detroit River by the Sauk and St. Joseph trails. The latter ran in a northeasterly direction up the valley of Dowagiac Creek, then along a section of land-laid moraine to the Kalamazoo River, which it followed with a due easterly orientation to a right bank tributary of the Huron River; the valley of this stream facilitated the linking up with the eastern end of the Sauk and the Shore trails.

It is unfortunate that data are lacking for the completion of a western trail from Mackinaw to Niles; otherwise the triangular pattern would be strikingly illustrated. Traces of a trail down the west coast have been discovered, but not enough to warrant the inclusion of a western trail in this study. The two other sides are shown by the Sauk and St. Joseph trails on the southern side of the triangle and the Shiawassee, Saginaw, Cheboygan and Mackinaw

trails on the eastern side. That there is a correlation between the pattern of the surface features and the pattern of direct lines between the points of external contact is shown by variations of these trails from the straight line. In every case the variation is capable of explanation by some surface feature.

Whether the east-west routes in Indian times were of more importance than the north-south routes is difficult to determine. The line of the Great Trail, the convergence of travel lines in the southeast of the state, the village grouping at both ends of the Sauk Trail, all point to an emphasis on east-west routes, yet a widespread distribution of copper from the Upper Peninsula must have occasioned frequent travel north and south. Probably the Mackinaw, Cheboygan, Saginaw and Shiawassee trails were of equal importance with those of the Sauk, St. Joseph and Grand River.

The entrance of the white man upon the scene introduced another phase in the road pattern.

THE COMING OF THE WHITE MAN

The state of Michigan was for some time sheltered from the feet of white intruders during the early part of Colonial history. At the end of the sixteenth century and the beginning of the seventeenth, the English were making a footing on the New England coastal plain, while the French were pressing up the St. Lawrence. The presence of the haughty and powerful Iroquois nation in the region stretching from the eastern end of Lake Erie to Lake Champlain kept the adventurous French, to whom the Indians were hostile, to the north. The English at this time were bent on consolidating their agricultural settlements east of the Appalachians and so they had no great call to test their rather nominal friendship with the Iroquois. The French settlements began with traders' huts, fortified posts and missionary stations; their objects were fur-trading, dominion and evangelization. The English settlements began with outlying villages and farms; their object was agriculture.

In 1634 Jean Nicolet, following the paths of Le Caron, a Récollet friar, and at a later date Champlain, traveled up the Ottawa and Mattawa rivers, made the short portage to Lake Nipissing and

thence by the French River and Georgian Bay to the "Mer Douce" (Lake Huron), eventually going on to Green Bay. It is significant that the first and most important French posts were at Sault Ste. Marie and Saint-Esprit (near the head of Lake Superior); these were settled in 1668. The southern parts of Lake Huron and Lake Erie were neglected. In 1669 a mission post was founded on the Island of Michilimackinac, in the Straits of Mackinac; the settlement was subsequently moved to the mainland. This was the first French recognition, although it was probably unconscious, of one of the main points in the Indian trail pattern. The Indian settlement through its strategic position attracted priests, traders and soldiers. Some ten years later La Salle ascended the St. Joseph River and founded Fort Miami; this settlement persisted through many vicissitudes, until it was eventually superseded by the building farther up the stream of Fort St. Joseph. But it was not until 1701 that a French settlement was formed at Detroit and even then its founder, Cadillac, came by the Georgian Bay and St. Clair River route. Detroit was not founded by the French primarily because it was on their east-west line of travel, but chiefly for other reasons. The "Thumb" of Michigan provided some of the best known beaver grounds; the poorly drained morainic country was particularly suitable to the beavers as a habitat. There was also great danger that the English, by virtue of their friendly relations with the Iroquois, would travel along Lake Erie and up the Detroit River, and so exploit these beaver grounds, of which Detroit was then a guardian. It was also a center for the evangelization of the neighboring villages as well as an excellent port for the shipping of skins.

Although the French preferred to travel by way of the Lakes, it must not be supposed that they confined themselves to them. The following extract shows how much the settlers were dependent upon the Indians: "Detroit habitants also cultivated the soil, but that settlement drew large quantities of supplies from the Illinois." [2] It is hardly likely that a long journey was made when a much shorter one by land would serve the same purpose. It is beyond doubt that considerable use must have been made of the

[2] B. A. Hinsdale, *The Old Northwest* (New York, 1888), p. 50.

Sauk and St. Joseph trails by the traders and *coureurs des bois* in their journeys to the western side of the state. Although in 1749 French reports stated that English traders were swarming into the Maumee Valley, and although in 1763, when Canada was ceded to England, more traders came into this region, yet no new centers were developed and the early pattern remained unchanged except for a somewhat greater emphasis on the east-west routes and the growing importance of Detroit, owing to the opening up of Lake Erie as a line of travel.

THE INTRODUCTION AND APPLICATION OF THE RECTANGULAR SURVEY

The year 1783 saw the end of the American War of Independence and the beginning of disputes about the extent of the territories of the several states. Between 1780 and 1802 the problem was solved by creating in the west, under the federal government, a vast territory which was to be called the "public domain" and which was later to be split into new states. Numerous and frequently large tracts of this territory were sold to potential settlers and these purchasers naturally had their land surveyed, with the result that overlaps or narrow strips between the various purchases were frequently noted and were a source of constant dissension. Great need was felt for the systematic survey of the area. In 1785 an ordinance was passed establishing the subdivision of the "public domain" by means of rectangular surveys. Since the township plan had previously been used in New England, the rectangular survey was by no means new, but it was recognized that this kind of survey afforded a security of title which provided an orderly settlement of new lands. The novelty of this system as it was applied to the "public domain" lay in the determination to make "careful surveys of the townships six miles square and of the thirty-six internal sections in each, before disposing of the public lands." [3]

As late as 1805 the inhabitants were very much backwoodsmen and the total number in the Michigan area was only some eight thousand. Detroit was the nominal head of this area and it owed

[3] From the Ordinance of May 20, 1785.

this status to its previous position as an important fur-trading center and a fortress. A series of events took place soon after this which greatly stimulated interest in Michigan and led to its subsequent development. In 1817 the first steamboat *Walk in the Water* appeared on Lake Erie; in the same year the Erie Canal was begun and it is significant that in 1819 Congress, in anticipation of the boom, organized the lower tier of counties in the Michigan area. The opening of the Erie Canal in 1825 greatly aided the outpouring of settlers from New England and New York, as is shown by the following figures. The population of the Michigan area in 1820 was 8,000; in 1830, 31,000; in 1840, 212,000.

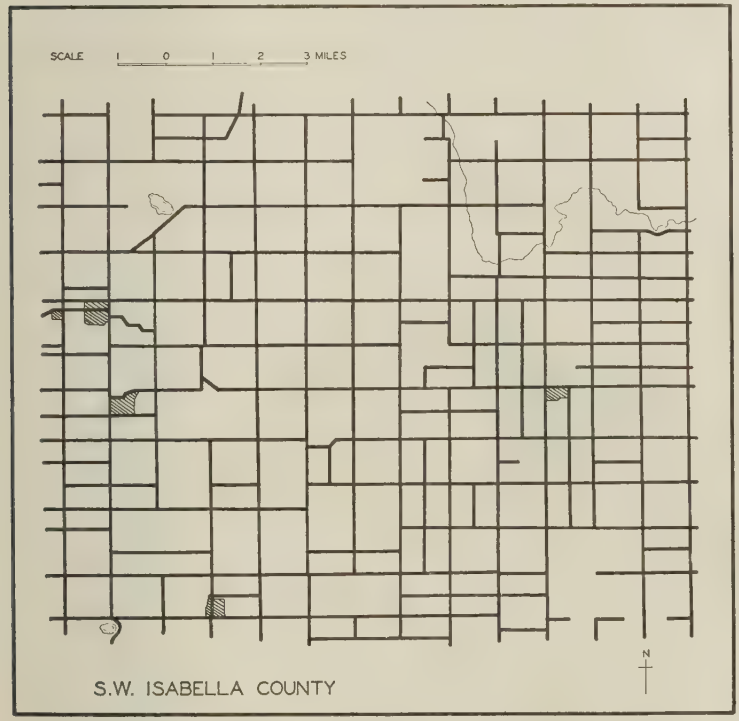
The division of the land into rectangles, oriented to true north and south, necessarily involved the construction of roads the pattern of which would conform to the plan of land divisions. There were, however, several obstacles which were not to be overcome; they may be classed as "natural" and "cultural," although this division is purely arbitrary. Lakes, swamps and rivers may be classed as "natural obstacles"; previous settlements, such as Detroit, and established routes of travel may be classed as "cultural obstacles." There is a well-founded principle that a thing established tends to persist.

In an area of glacial deposition like the Southern Peninsula of Michigan lakes and marshy tracts are scattered over the surface in great abundance, so that it is extremely difficult to select a type area of rectangular pattern which does not have some modifications because of lakes and marshes. (See Map 8,[4] in which there is shown a minimum of modification in the pattern by lakes and marshes, as opposed to Map 10, in which the marshes and lakes cause great alterations in the pattern.) Since the whole area is one of low relief, there are no modifications on account of gradients which might prove too severe to be practicable. The presence of rivers, although not necessarily a modifying factor, frequently was one, since to avoid unnecessary duplication of bridges on the little-used routes there would tend to be a concentration at bridgeheads; numerous examples can be found on the topographic map of roads

[4] Maps 8-13 are taken from the road maps of the State Highway Department, Lansing.

following the bank of a stream some way before crossing it. (See Map 9, in which roads run along the bank of the Grand River and tie in the ends of the rectangular roads to the bridgeheads.)

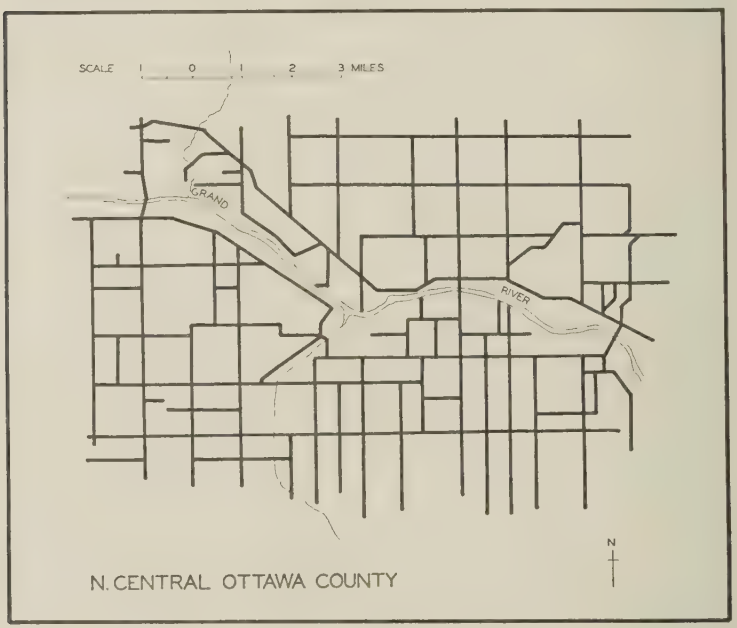
The cultural influences had their greatest effect in the southern



Map 8. Typical rectangular road pattern in the state of Michigan

part of the area. Mackinaw had not grown at a rate in any way commensurate with the growth of Detroit; the Erie Canal was responsible for this. Detroit had become a center, and had a focal, and, conversely, a radial road pattern; the Indian trails had formed the nucleus of this, but the increasing importance of connections east and west as compared with those north and south had accen-

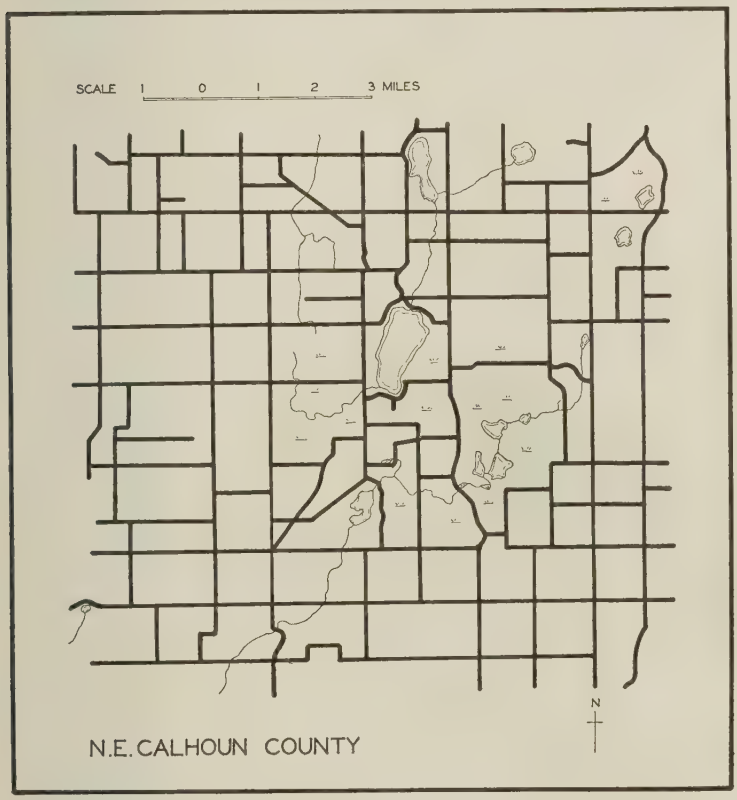
tuated this. The point of concentration had moved from southwest Michigan into northeast Illinois, at Chicago, and there was a growing interest in the lands west and southwest of Lake Michigan; all of which tended to emphasize the function of the routes west from Detroit to such an extent that no arbitrary route was able to



Map 9. Modification of rectangular pattern by river

disturb those already established. Moreover, in the disturbances at the beginning of the nineteenth century the old St. Joseph Trail was used by the military and it survived for a long time as the Territorial Trail. On the other hand, the routes in the northern part of the area, owing to the fact that their functions as routes were for a time in a decline as compared with those of the south, took on a decidedly angular appearance as a result of the rectangular survey. In southeast St. Clair County (see Map 11) the roads

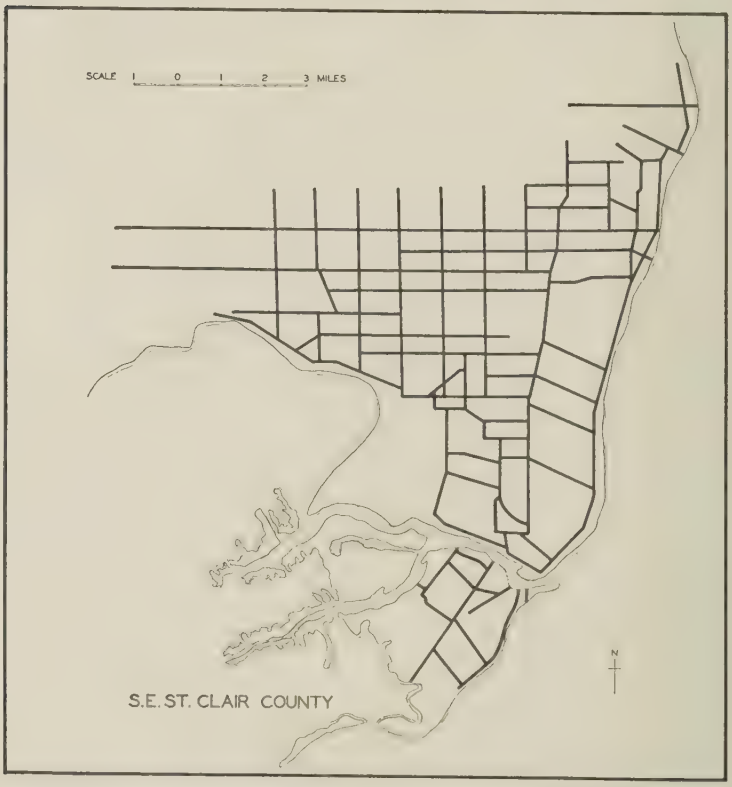
show a distinct tendency to be oriented at right angles to the River St. Clair. A pattern like that formed by the roads of the old "shoe-string" farm settlements of the French along the St. Law-



Map 10. Modification of rectangular pattern by lakes and marshes

rence River, where every original land grant had some river frontage, points to an influence before 1785. Minor modifications are also noticeable, owing to the inability of surveyors to tie the section lines in accurately. This caused a slight offset in an otherwise straight road (see Map 12).

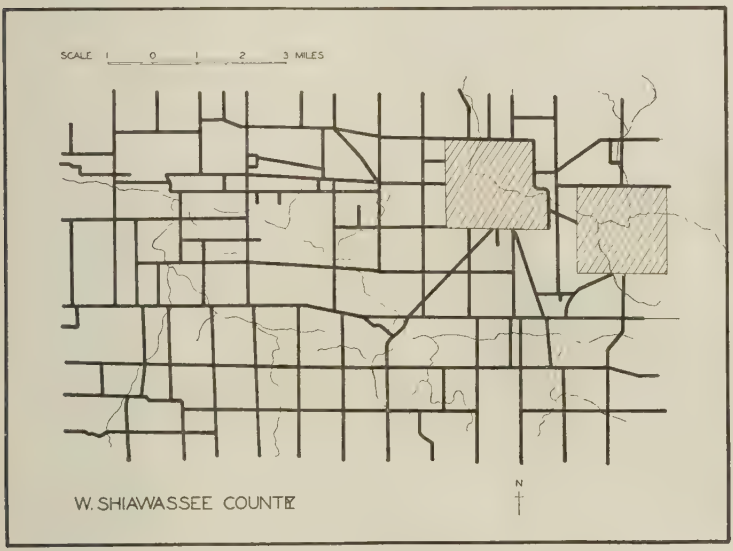
It may be seen that the creation of roads according to the rectangular pattern means the creation of "nominal" roads that may be functional roads, but are not necessarily such; in fact the pat-



Map 11. Modification of rectangular pattern by earlier settlement

tern may be called an artificial one. The mere laying out of a strip of land and surfacing it with the necessary material to make it appear like a road does not mean that it will be utilized as a road. It has to have a definite function as a route of travel. The rectangular survey, with its accompanying road pattern, is an

extremely efficient method of dividing up land of low relief, at an early stage in development. But as soon as the favorable sites are developed at the expense of those less favorable, urban formations spring up and the need for direct communications is immediately felt. Moreover, the urban centers are rarely so accommodating as to situate themselves at the ends of corresponding due east, west, north and south lines. In any case, as soon as there



Map 12. Modification of rectangular pattern by surveying errors

are more than two centers, the problem of diagonal communication has to be faced, and at the expense of modifying the rectangular pattern.

FURTHER MODIFICATIONS OF THE RECTANGULAR PATTERN

During the present century there has been an enormous increase in the urban population of the state, while the rural population has shown a decrease. In the ten-year period 1900–10 the urban population increased from 952,000 to 2,241,000, but

the rural population decreased from 1,468,000 to 1,426,000. The meteoric growth of Detroit incidental to the popularity of the automobile has been largely responsible for this. Moreover, the introduction of the automobile itself has caused a concentration of markets; the large town has further increased its size at the expense of the smaller town. To take a local illustration, the journey from Dexter to Detroit and back (some 80 odd miles) would have been a very good two-day trip previous to 1900, but with a modern automobile three hours is ample time. Although formerly the rural dweller around Dexter had to buy and sell in the small town or waste an enormous amount of time, he now transacts his business in a larger city where there is a more comprehensive market for both buying and selling. The outcome of this is the desire to travel rather long distances in a short time. Therefore, in its capacity of guardian of the public weal, the state has to see that roads are in such condition as to be able to meet the new demands which are made of them. In a state like Michigan there are two ways in which a road may be adapted for fast traffic: first, by improving the surface, which, of course, leads to no change in the pattern and, therefore, will not be considered here; second, by straightening the route and obviating all unnecessary turns. On the rectangular pattern, any travel which was not in a due north-south or east-west direction involved frequent right-angled turns, an oblique direction only being achieved by a series of steps. The flattening out of these steps resulted in a considerable shortening of distances. Examples of this type of road improvement are too numerous to mention specifically. They are to be found half a dozen times along U. S. Highway 16 between Ann Arbor and Grand Rapids and this situation is typical for the state (see Fig. 9). It is noticeable that the greater the function of the route the sooner it tends to lose its rectangular characteristics. For instance, the main roads from Detroit to the southwest have lost what little of the rectangular pattern they ever acquired; route U. S. 16, although still retaining some rectangular features, is rapidly becoming straightened, but many cut-off corners are noticeable on route U. S. 27 from Lansing to Cheboygan, although there are still right-angled bends on the latter route. The second-

ary roads are, as yet, practically unmodified from their original pattern. It is significant that the sections of the state remote from the urban centers and their connecting links tend very markedly

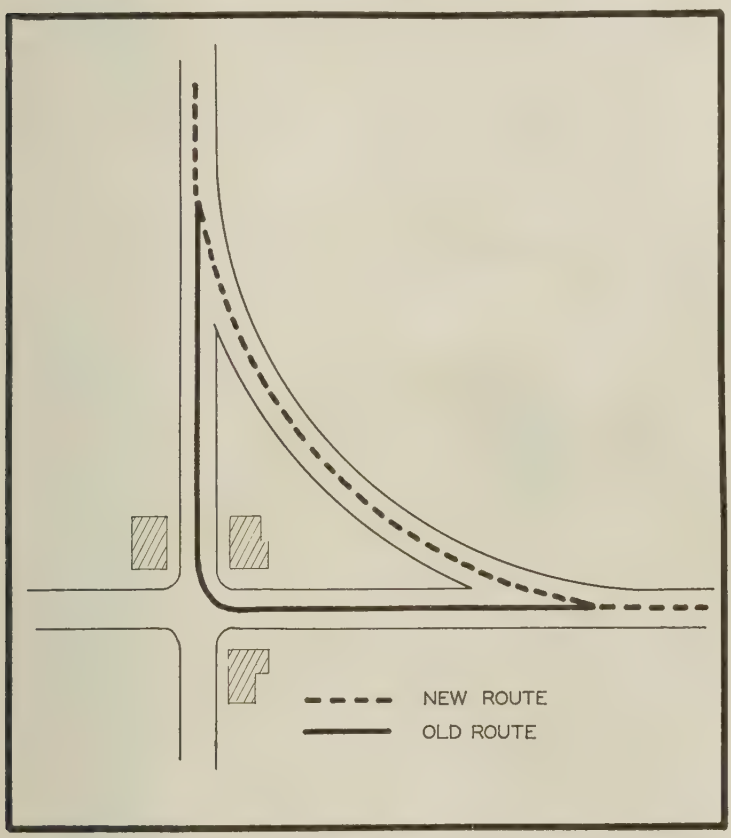
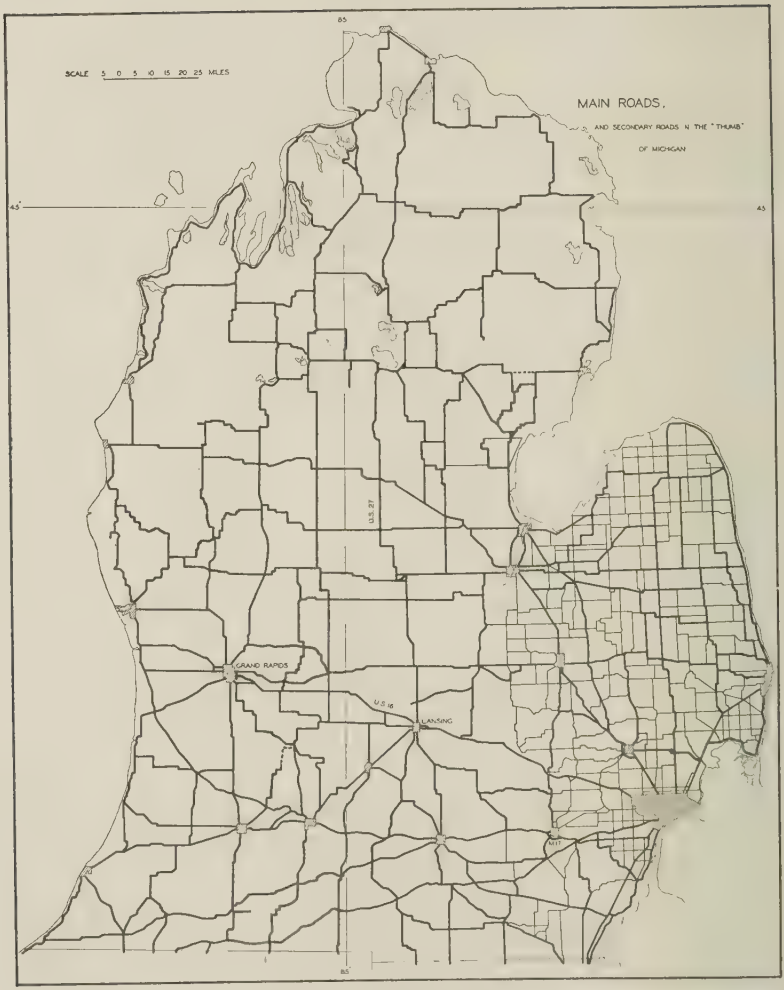


Fig. 9. Modification of the rectangular pattern by typical "cut-off"

to retain their rectangular pattern; the "Thumb" of Michigan provides an excellent example of this (Map 13).

In the urban centers, which are essentially artificial in their setting, there is a tendency to use the rectangular pattern, for it



Map 13. Road map of the Southern Peninsula, showing secondary roads in the "Thumb" and main roads in the rest of the Peninsula

admits of an orderly arrangement of lots and a consequent saving in space. There is, however, one modification which has come with the increase in the function of the urban center as a point of concentration; that is the development of a marked radial road pattern. On the other hand it may be only an accentuation of this radial pattern by the filling in of the space between the arms of the roads, as in the case of Detroit, which had such a pattern in the days of the Indians and French settlers. There is a tendency, which is more marked in the pattern of some English roads, for "by-pass" roads to be constructed to enable traffic to miss the centers of the smaller towns; such a road now exists on the outskirts of Ann Arbor (route M–17). This again is the direct result of the growth of "through routes" incidental to the development of high speed traffic, the concentration of markets and consequent congestion of towns.

The uniform surfaces of the old lake plains surrounding the Southern Peninsula were recognized as possible routes, even in Indian times, but with improved drainage and a general lowering of the water-table of the whole state, it has been made possible to encircle almost the entire Southern Peninsula with a road.

CONCLUSION

The road pattern of the Southern Peninsula may be said to have passed through two phases and to be now well advanced in the third. In the first phase, which may be called one of natural pattern, a road or trail was developed only as the necessity for it arose and its importance was in direct proportion to its function or use as a route of travel. The second phase was an artificial one; roads were created which had no justification for existence; many of these were purely "nominal" roads and had no functional significance. A journey along one of the modern state highways will show "nominal" roads, a strip of land inclosed by parallel fences and exhibiting few signs of use. The rectangular road pattern could not cope with the complex distribution of centers of population, since by it the principle of the road as the easiest and shortest route of travel between two points was neglected. The third or

contemporary phase is a return to a natural pattern, but with many modifications inherited from the intervening artificial phase.

University of Michigan

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SPANN: A COMMUNITY STUDY IN THE CUMBERLAND PLATEAU OF KENTUCKY *

ROBERT M. GLENDINNING

LARGER CONSIDERATIONS

THE Appalachian Plateaus lie in a narrow, elongated belt from the Mohawk Lowland on the north to northern Alabama on the south, being flanked on the east by the Appalachian Mountains and on the west by the Interior Lowlands. The northern half of this plateau belt, in general the glaciated portion, is called the Allegheny Plateau, as distinct from the southern and unglaciated portion or Cumberland Plateau. This paper is concerned with a small area of the Cumberland Plateau located on its west-central edge, just east of and contiguous to the Pottsville escarpment (see Map 14). Though this paper is not intended to be a definite type study of the plateau province, yet the general conditions described will hold for the western edge of the Cumberland Plateau as a whole.

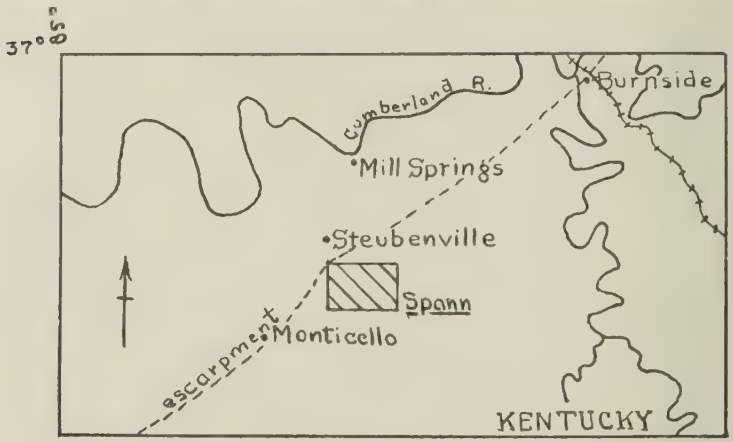
The movement of white people into and through the Plateau began as early as 1770, but the real impetus of the westward surge occurred with the first decade of the nineteenth century. The people were of Scotch-Irish and English descent and came from North Carolina and Virginia by way of Cumberland gap. Such names as Boone, Sevier, Harrod and Robertson recall the perseverance and struggle for new lands in the western wilderness. Some pushed on to the famed Blue Grass, others remained in the plateau. Those who remained did so because of fatigue, loss of draught animals, or because the plentiful game, timber and sweet water provided ready food, shelter and drink.

* Paper from the Department of Geography of the University of Michigan.

THREE VIEWS OF THE SPANN AREA

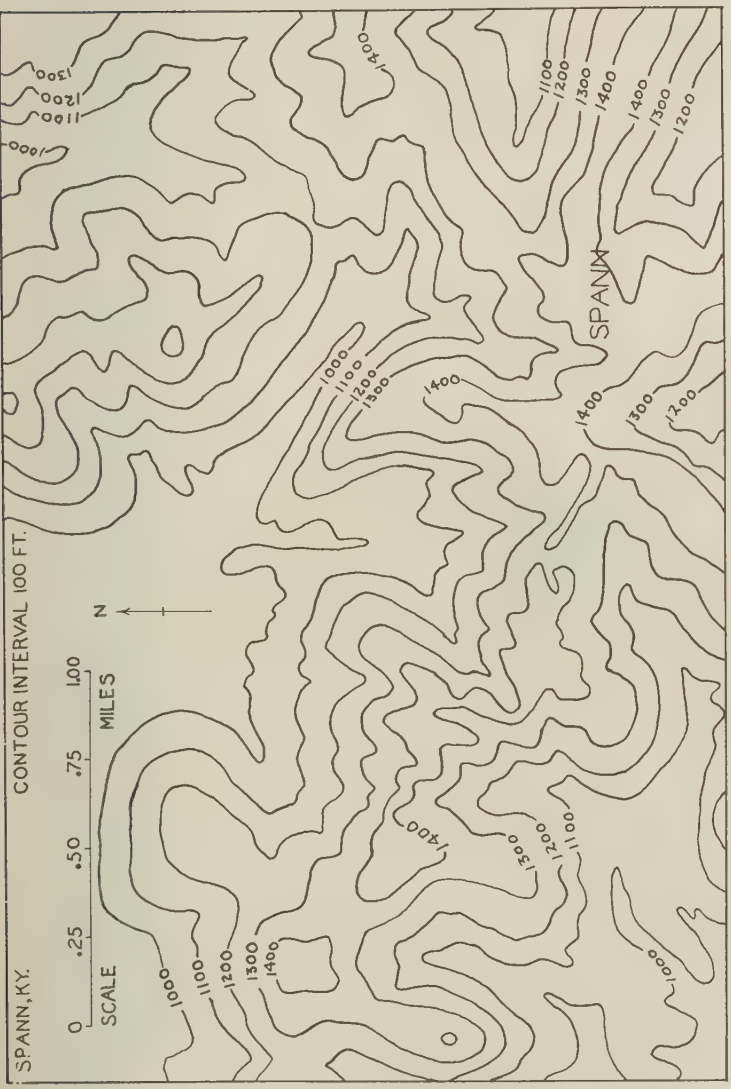
From the adjacent Highland Rim the escarpment of the Cumberland Plateau stands up as a high, green wall, unbroken by roads, cultivated lands or buildings. Because of the continuous forest blanket the plateau appears, from a distance, as if untouched by human occupation.

Within the plateau there are two characteristic perspectives, one from the ridge tops, the other from the valley bottoms (see Map 15). From the ridges one sees the distant, forest-covered



Map 14. Location map

swells of the close-packed ridge tops with their crests all in the same horizontal plane. Closer to hand are the deep valleys with their forested sides rising steeply to the narrow tops of the ridges. Here and there in the valleys and on the ridge flanks the green blanket is broken by small houses with associated corn-fields and pastures. The fields on the slopes seem about to slide off into the valleys, so steep are the valley sides. From the valley bottoms the view is very limited. One sees only the small clearing in which he stands flanked on either hand by the valley sides, with perhaps a glimpse in the upper distance of a ridge-top farm with its rail fences and ramshackle buildings.



Map 15. Relief map

THE COMMUNITY

The community of Spann proper occupies the narrow, curving Spann ridge. It derives its name from John Spann, who has been living in one of the adjacent side valleys for sixty-eight years. It consists of a general store, post-office, Methodist church, an eight-grade one-room school and some twenty scattered dwellings. Its population numbers seventy-five. Very poor roads lead down to the Highland Rim to form ultimate connections with Monticello and Steubenville; worse ones lead back into the plateau interior. These roads are the offspring of the old Indian hunting trails which connected the plateau proper with the Highland Rim and the Blue Grass. They are stream-bed roads or ridge roads, depending on their location. It is to this coalition of avenues that Spann owes its existence (see Pl. L, Fig. 2, and Map 17).

The Spann area, except when settled by the white people, has been little affected by immigration or emigration. The descendants of the early settlers still occupy the lands. Inertia and family ties tend to hold people, while lack of industries and paucity of arable land discourage immigration. Families average five persons, whose increase has resulted in a mounting number of farms on the same land area. Backwoods traditions and viewpoints still hold in speech, mode of livelihood and mental outlook. Because of certain dominant factors, to be mentioned at once, Spann has remained a frontier community to this day, and this is strikingly shown in the appearance of the area.

IMMEDIATE CONSIDERATIONS

The landscape of Spann owes its characteristic appearance to the inter-relationship and influence on other elements of three dominant factors: isolation, surface and soils.

Isolation. — Spann has been continuously handicapped by an extreme isolation, but little modified to the present day. Burnside, the nearest railroad station, is twenty miles distant, and can be reached only by descending to the Highland Rim and following the Burnside-Monticello Pike. Automobiles can reach the Spann ridge by way of the Steubenville road, but only at great cost to

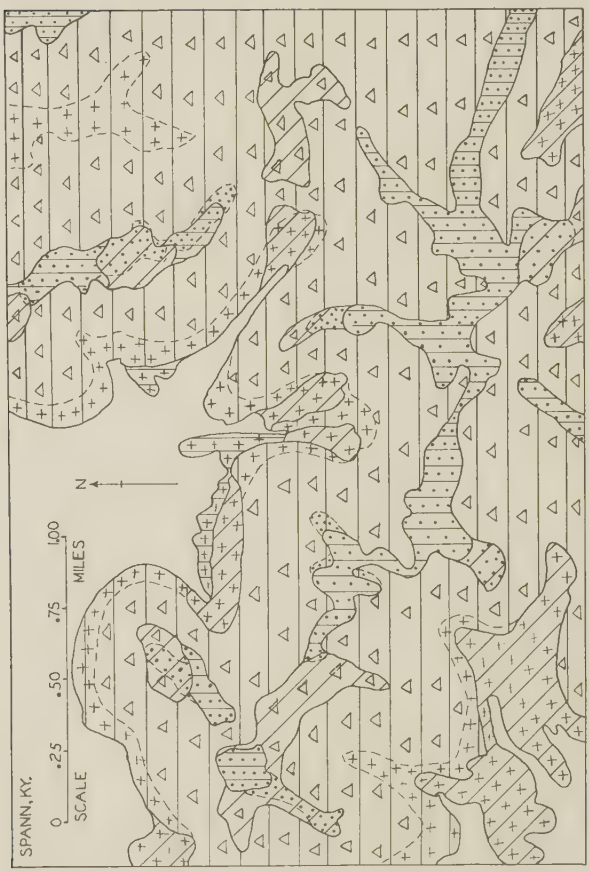
engine and springs. Beyond the Spann ridge travel is limited to foot, mule-back or mule team. Spann boasts but three automobiles, a dilapidated Ford truck and two light touring cars. A single telephone wire leads from Monticello to Spann; it was found to be working once in a period of seven weeks. There are no radios and the nearest telegraph is at Burnside.

As a result of these conditions the area is more or less cut off from the rest of the world and the people produce and consume their products practically *in situ*. Of course, if other factors, such as soil and surface, allowed a considerable production the isolation owing to poor roads and communications would be speedily modified.

Surface (see Maps 15–16). — The area has an average relief of three hundred and fifty feet to the quarter mile. Narrow, rounded ridges and deep V-shaped valleys are characteristic. Flat areas are limited to the restricted valley bottoms and ridge tops. As regards degrees of slope (defined in Map 16), No. 2 slopes occur on the ridge tops and, to much less extent, in the valley bottoms. No. 3 slopes are found generally in the valley bottoms, but also in small patches on the ridge tops and side-hills. No. 4 slopes cover by far the major portion of the area, occupying the flanks of the ridges. The influence of relief on land utilization is clearly shown on the land utilization map and in the tables on page 337. Of the total land area only 6.79 per cent is cropped, and the greater portion of this is found on the limited No. 2 and No. 3 slopes of the ridge tops and valley bottoms. Ninety per cent of the steep No. 4 slopes of the side-hills is in woodland.

The conditions of the surface are likewise reflected in the location of the ridge and stream-bed roads and in the rapidity of drainage, with its accompanying sheet erosion and prominent gullying, especially on the No. 4 slopes.

Soils (see Map 16). — The parent material of the Spann soils is a coarse-grained sandstone. The soils, originally none too rich, have been robbed by gullying, sheet erosion and leaching, not to mention soil depletion as a result of unintelligent use. There are three types of soils in the area, the Cumberland Sands of the ridge tops, the Cumberland Thin-Stony of the side-hills, and the Cumberland



Map 16. Soil and slope map

Colluviums of the valley bottoms and colluvial bases of the ridges. The Cumberland Sands have a brownish-yellow color, are very coarse textured, and are notably deficient in lime and humus content. The Cumberland Thin-Stony type, which is medium brown and coarse-textured, has many rock fragments and is less leached than the ridge soils. The Cumberland Colluviums are dark brown, and of medium texture and represent the richest soils of the area. Thanks to conditions of surface, these latter soils are constantly supplied with new materials by soil wash and soil creep.

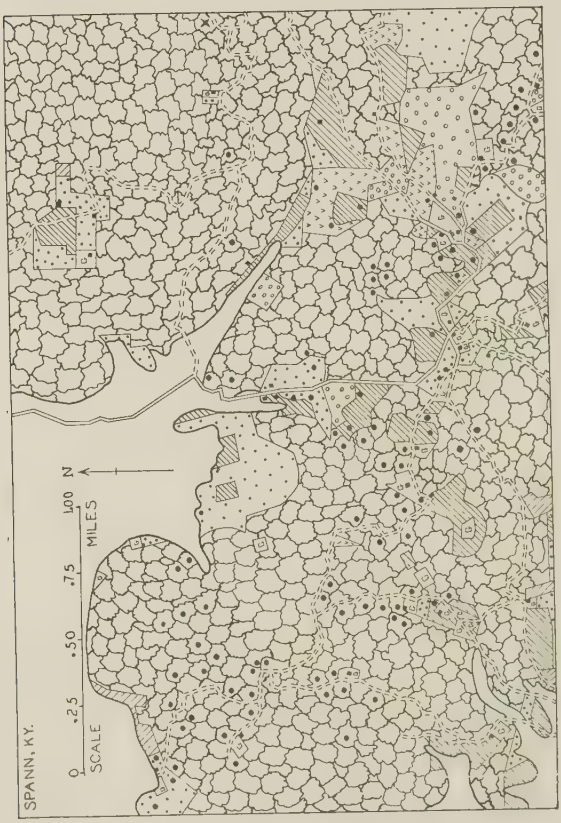
Climate, as well as surface, has its effect on edaphic conditions. The area has a Cfa type of climate (Köppen) characterized by long, hot summers and short, cool winters. Rainfall averages forty-eight inches annually; it is fairly evenly distributed. Summer rains fall during violent thunder showers; winter precipitation comes as rain or snow during cyclonic storm periods. Under these climatic conditions flat areas develop a thick soil mantle, but areas of steep slope quickly lose their soil materials to the lower lands.

Corn production shows the control of crops by soil. The ridge soils produce on the average fifteen bushels of cob corn per acre, the side-hill soils eighteen bushels, and the valley bottom soils twenty bushels. The average for the United States in corn production for a representative year (1928) was 28.2 bushels.

Soil has a minor effect on natural vegetation also. Where it is very thin or lacking we find small cedar glades clinging to the exposed rock ledges.

Woodland (see Map 17 and p. 337). — Originally the entire Spann area was forested with first-class commercial timber. At present 84 per cent is still in woodland, but, as a result of past logging operations, this stand is now second- and third-class material throughout. Of this present stand 95 per cent occupies the steep slopes of the side-hills, 3 per cent the ridge tops, and 2 per cent the valley bottoms. The woodland is composed chiefly of elms, oaks, hickories, ashes and maples. The only softwoods are the small cedars, which are found in disseminated patches on the side-hills. From an areal standpoint these cedars are insignificant, constituting at most less than 1 per cent of the total woodland.

The woodland furnishes fire-wood, fence rails, shingles, mast,



Map 17. Land utilization

pasture and a few logs for lumber. Exploitation is desultory, haphazard and on a small scale; it is not limited to any one portion of the area. The individual log seeker fells a tree here and there and enlists the aid of his neighbor to haul it to Mill Springs landing on the Cumberland River. A recent development, destined to be short-lived, is the exploitation of the cedar glades. At the present rate of cutting the supply will be exhausted in two or three years. This wood goes to Monticello to supply a small pencil and cedar

TABLES

Land valuation figures obtained at Monticello, Kentucky, the county seat. All other statistics are based on field survey.

Total area, 3,255 acres

1. Woodland, 2,735 acres	84.02%
2. Pasture, 217 acres	6.66%
3. Corn, 170 acres	5.25%
4. Waste land, 84 acres	2.58%
5. Garden and orchard, 44 acres	1.35%
6. Oats, 6 acres	.0018%

Cropped land, 6.79% of total

1. Corn	77.00%
2. Garden and orchard	20.00%
3. Oats	3.00%

Ridge land, 163 acres, 5% of total. Corn yield, 15 bu. cob per acre

15% in crops	Land in crops
20% in pasture	Corn 72%
15% in waste land	Oats 1%
50% in woodland	Garden and orchard 27%

Side-hill land, 2,897 acres, 89% of total. Corn, 18 bu. cob per acre

4% in crops	Land in crops
4% in pasture	Corn 85%
2% in wasteland	Oats 2%
90% in woodland	Garden and orchard 13%

Valley bottom land, 195 acres, 6% of total. Corn, 20 bu. cob per acre

40% in crops	Land in crops
35% in pasture	Corn 67%
1% in wasteland	Oats 4%
24% in woodland	Garden and orchard 29%

Land valuations

	Average value per acre
Ridge land	$11.50
Side-hill land	$12.00
Valley bottoms	$15.00

oil factory. Under such conditions of method and supply lumbering furnishes little revenue to the farmer of Spann.

Cleared land. — The area not covered by woodland constitutes 16 per cent of the total land surface of the Spann area. This cleared portion is devoted to roads, buildings, yards, gardens, orchards, pasture, field crops, and waste and brush land (see Map 17). Sixteen per cent of the cleared land lies on the ridge tops, 55 per cent on the side-hills, and 27 per cent in the valley bottoms.

Pasture claims more of the cleared land than any other use, namely, 41 per cent. Of this 41 per cent given to pasture 15 per cent occupies ridge land, 54 per cent the side-hills, and 31 per cent the valley bottoms. Corn (see Pl. L, Fig. 1; Pl. LI, Fig. 1), the chief crop, ranks second in its demand on the cleared land, with 33 per cent. Of the land devoted to corn 10 per cent is on the ridge tops, 58 per cent on the side-hills, and 32 per cent in the valley bottoms. Waste and brush land takes up 15 per cent of the cleared area, of which 29 per cent occupies the ridges, 69 per cent the side-hills, and 2 per cent the valleys. Gardens, orchards, yards and buildings are very closely associated and jumbled together; they claim 8 per cent of the cleared land. Because of their intimate association on small plots the area given to them as a group is taken. There are more buildings and gardens on the ridges, but their occupied area is less than those on the side-hills and much less than those in the valley bottoms; the areal ratio is about 2 : 3 : 5, and the numerical ratio about 5 : 3 : 2. Oats occupy only 1 per cent of the cleared land, and this small total area is distributed on the ridges, side-hills and valley bottoms in respective percentages of 4, 41 and 55 per cent. Roads, being few and narrow, require but 2 per cent of the cleared portion.

In addition to the distribution pointed out in the preceding paragraph, a more detailed picture of land use within the ridges, side-hills and bottoms themselves may be had from the tables on p. 337.

It is from this cleared land that the people of Spann gain their living, for, although only 7 per cent of the total area is cropped, agriculture is the leading occupation. Agriculture in the Spann area is an activity carried on in the face of the drastic dictates of soil, surface and isolation; it is carried on, not because of, but in

spite of, conditions. The farmer lives unto himself and his family, holding virtually no intercourse with the outside world. He devotes his energies chiefly to his corn-field, since corn furnishes the basic food for his family and his livestock. Modern machinery is not used by him, for the lack of capital, the nature of the surface and the small land holdings force him to adhere to the plow, the hoe and the small cultivator. A small orchard and garden furnish him with fruits and vegetables, some of which he barters at the general store in exchange for household necessities. His farm animals, usually constituting one mule, four or five hogs, fifteen to twenty chickens and perhaps a milk cow, aid him with the farm work or help feed him. The animals forage for themselves in the woods and pastures most of the year, being ration-fed only for fattening or at odd periods in the winter season. In addition to food the animals bring him a small monetary income. Two or three hogs are sold each year. They are driven to Steubenville, from which they are trucked to Burnside. Chickens and eggs are bartered at the general store. His tools are purchased "on time" in Monticello and his other outside needs come through the various mail-order houses. His farm production could be increased somewhat with the use of fertilizers and scientific methods of horticulture and animal husbandry; but who is to educate him to their use, and, above all, who is to pay for them? His shack-like house and fragile, shed-like barns give at once a hint as to the general conditions of his existence.

Mineral resource. — There are ninety-eight oil-wells in the Spann area, only fifty of which are still being pumped. These are located chiefly on the flanks of the Spann ridge (see Map 17). At present the average daily yield is but one-half barrel per well. A large oil company of western Pennsylvania holds the oil rights, for which privilege it pays to the farmer one eighth of the value of the crude oil obtained, a matter of eight or nine cents per well per day. These wells were first driven in 1908, at which time the pools tapped yielded an average of thirty barrels a day to each well. Now the pools are virtually exhausted and the miniature boom is over, with nothing left to show for it except the tripods of the derricks and blasted hopes. The oil flows by gravity line to Steubenville

on the west or to a station to the east, the direction being determined by the position of the wells on the ridge. From both points it is pumped on to Burnside.

There are three small coal mines in the area, only one of which is even partly operated. The mine being worked is a family affair employing three persons; the miner, who is also a farmer, his young son and a truck driver (see Pl. L, Fig. 3; Pl. LI, Fig. 2). When in operation, the mine produces about three tons of medium-grade bituminous coal a day. This retails in Monticello for $4.50 a ton, when there is a market for it. Some coal is sold at the mine to farmers who do their own hauling; disposed of in this way it brings $2.00 per ton.

Though mining, like lumbering, is of little total importance, still it brings a few much-needed dollars to the area. The scarcity of money in the area is brought out by the fact that few households see more than $50.00 in cash the whole year through. The resulting low buying power is owing to the low production, which in turn is caused by the culmination of effects growing out of the dominant factors pointed out above.

CONCLUSION

As mentioned in the first paragraph of this paper, other communities in the Cumberland Plateau have essentially the same landscape expression as Spann, and as nearly as can be determined this characteristic appearance is owing to the control exerted by the dominant elements of isolation, surface and soils. Thus the thesis of this paper seems to be substantiated not only in the area just considered, but also in similar areas. All have been settled by people with the same cultural background, who have faced the same natural conditions and have made the same adaptations.

What of the future of the Spann community? Surface conditions cannot be changed. Soils, even though fertilized, will still be far from first class, and, since the farmer cannot afford fertilizer, soils will undoubtedly give smaller yields as time goes on. To be sure, the element of isolation will be slowly overcome and educating contacts may perhaps raise the cultural standard, but even this seems dubious in the face of the paucity of natural endowments.

FIG. 1. Side-hill corn-fields in the eastern part of the Spann area

FIG. 2. Creek bed road about to ascend the Pottsville escarpment

FIG. 3. Entrance to Spann coal mine

PLATE LI

Fig. 1. A field of ghosts; girdled corn-field on western Spann ridge

Fig. 2. Screener and stock at Spann coal mine

Probably the best use of the area would be for the production of forest products. This, however, would support very few people, so that it would not solve the problems of life faced by the inhabitants. Thus, on the basis of existing conditions and the improbability of any radical change in the near future, it seems that life will go on in the Spann community in much the same way for many years.

University of Michigan

COVER MAPPING IN SOUTHERN MICHIGAN

OTTO E. GUTHE AND KENNETH C. McMURRY

THE land inventory as practiced by the Land Economic Survey has become the fundamental basis for the planning of land use in northern Michigan for many conservation purposes. This inventory, with its precise presentation of the facts of soil, cover and economic condition, forms the background of scientific determination of assignment of lands to such purposes as game refuges, public hunting grounds, state forests, wilderness parks and the like. It is true that the inventory includes wild life only incidentally, but the relationships between wild life, cover and distribution of land types and uses are very close. Only the broader phases of this series of relationships are clear at present, but enough is known to make procedure much more definite than at any time in the past.

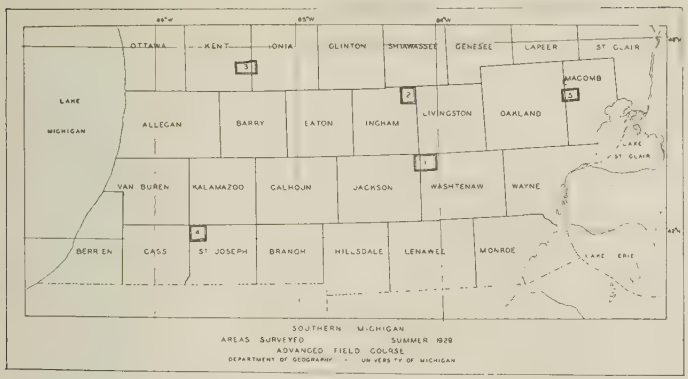
The counties mapped by the Land Economic Survey all lie in the north, and in the less settled parts, so that "wild land" is the principle type involved. The areal relationships of wild and agricultural lands are important, but granted an area of sufficient size, the characteristics of wild land are of chief importance. The game species of the north, deer, bear and partridge, are essentially associated with wild lands, with few close relationships to settlement. The results of the Survey, therefore, are of value in only a part of the state.

Southern Michigan presents a different picture. South of the latitude of Saginaw Bay, wild land in terms of the north disappears, and crop land assumes the dominant position. This southern half of lower Michigan ranks with the best agricultural sections of the country in terms of productive farm land, with 50 to 75 per cent of all farm land classed as improved. The problems of land use

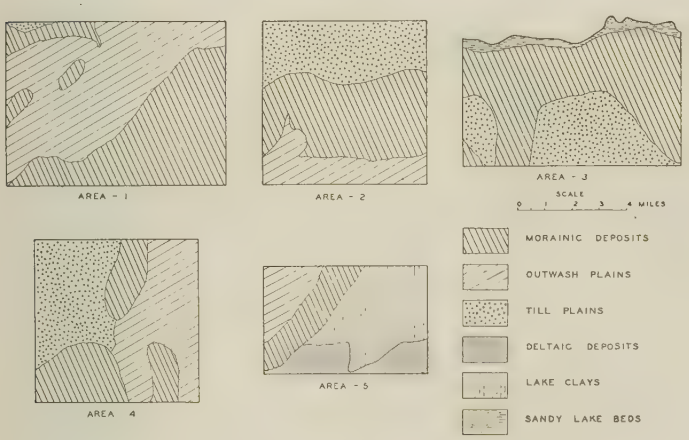
in this section differ entirely from those of the north. Instead of the problem of putting idle land into some form of use of recreational character, intensification and improvement of farm practice are of chief importance. Large-scale ownership of residual lumbering lands is replaced by individual farm ownership of small farms. Recreational use of land is a minor matter, rather than a major item.

In another sense recreational land is of greater importance in the south than in the north. Of 400,000 small game hunting licenses sold in 1929, about three fourths were for use in this southern agricultural section of the state. To be sure, this is but one of several types of recreational use of land, but it is sufficiently important to merit close study. Three hundred thousand hunters evenly distributed over 10,000,000 acres would mean less than forty acres per hunter, and the fact that some areas are far superior to others in stocking of game actually means a high degree of congestion in some sections during the hunting season. The large expenditure over several years for propagation of pheasants and their release in this southern country illustrates the appreciation of the problem by the state authorities. The demand for hunting facilities of good quality far exceeds the supply in this part of the state, a situation which is not duplicated in the major farm products of the area.

Farming methods, organization and procedure have received a large amount of attention over a long period. Millions of dollars have been spent in experiments, investigations and surveys. All classes of farmers are serviced in terms of their various types of production by extensive organizations, and by a background of fifty years of experimentation. The game crop has received but little attention. Legislation, attempting to limit seasons and bags, has been the major experiment in regard to this crop, with the addition of occasional planting of such exotic species as the pheasant in more or less haphazard manner. Lately, with the growing demand for the game crop, it has seemed probable that great improvement is possible. "Game management" has become a rather common idea among sportsmen. A field for investigation has been opened in which it seems possible that in time methods



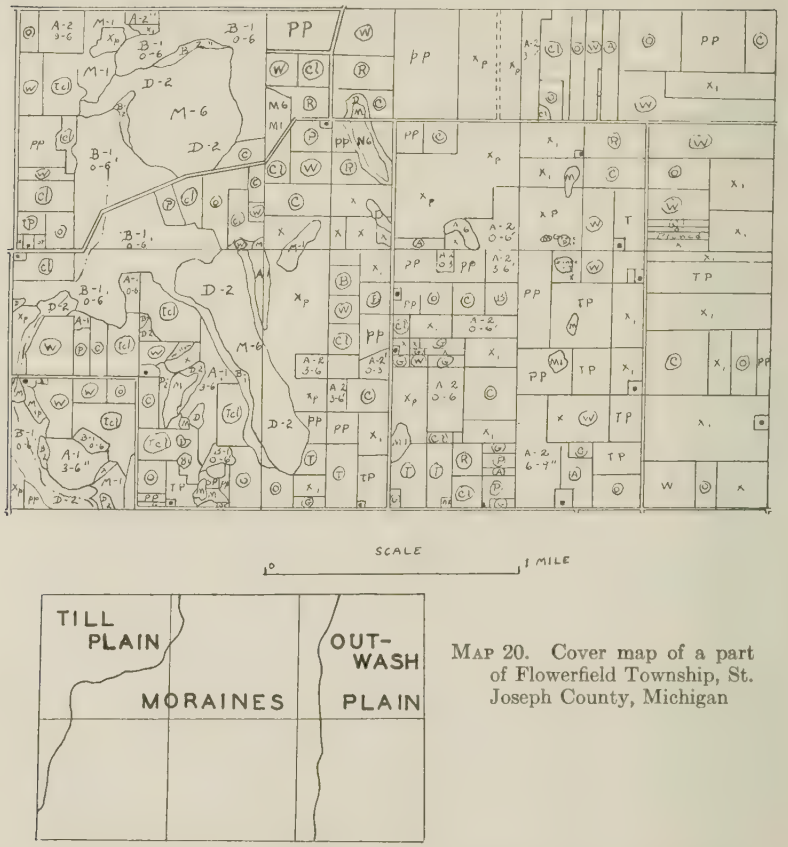
MAP 18



MAP 19. Surficial geology

of improvement analogous to those of scientific farming may be applied.

A possible first step in the development of scientific method to the game crop problem is the application of the land inventory method, which has proved so successful in the wild lands of the north. Since agriculture is well and permanently established in



MAP 20. Cover map of a part of Flowerfield Township, St. Joseph County, Michigan

the southern part of the state, and since the game crop is of minor importance in comparison with farming, the state probably is not justified in undertaking any such operations as those of the north. If the inventory is essential, some more simple and economical procedure is necessary. A method of sampling has been devised for this purpose. Map 18 illustrates the application of the sampling principle. Several townships were chosen, widely dis-

LEGEND FOR MAP 20

Timber sizes, 0–3″, 3–6″, 6–9″, 9–12″, 12–15″, 15″ plus at breast height
Timber stocking, ′ = poor, ″ = medium, ‴ = good

Upland timber associations

A1 — Oak, hickory, elm, basswood, white ash, cherry
A2 — Sugar maple, beech, oak, elm, hickory, white ash, cherry
A3 — Oak, hickory, beech, maple, ironwood

Swamp and semiswamp timber associations

B1 — Elm, ash, silver maple, swamp white oak, aspen, tamarack, willow
B2 — Tamarack, aspen, maple, elm, willow
B3 — Elm, ash, oak, silver maple, sycamore, beech, basswood, walnut, butternut, aspen, cherry, cottonwood, tulip
B4 — Pin oak, white oak, elm, red maple

Shrub brush associations

C — Brush and small second growth following lumbering
D1 — Willow, aspen, birch, sedges
D2 — Osier, huckleberry, ilex, tamarack, aspen, birch

Marsh associations

M1 — Sedge, bluejoint, shrub willow, aspen, birch, tamarack
M2 — Cat-tail, sedges, sagittaria
M3 — Water-lily, sagittaria
M4 — Lake bulrush
M5 — Buttonwood ponds
M6 — Leatherleaf sphagnum, blueberry

Non-cropped cleared lands

X — Apparently idle or abandoned land
PP — Permanent pasture
SP — Swamp pasture

Cropped lands

These lands are indicated by circles, with the following letters designating their use: A, alfalfa; B, beans; Be, beets; Br, barley; Bw, buckwheat; C, corn; Cl, clover; Fl, farm lot; Gr, garden; O, oats; R, rye; Rt, redtop; Sw, sweet clover; T, timothy; W, wheat. Any special crop may be written in.

tributed through the southern part of the state. To judge from topographic maps of the U. S. Geological Survey, soil maps, and maps of surficial geology, each of these townships is fairly representative of a much larger section of the state. A major difficulty arises from the fact that the structure of southern Michigan is extremely complicated, with wide variety of soil, surface and

drainage within small compass. There are no broad expanses of land of simple and similar structure, like those of the till plains farther south and west. Therefore townships are chosen which represent each of the major land types of the region in considerable area (Map 19). Moraine, outwash plain and till plain appear on the various maps, with an area of lake plain in one of the maps, and the relative areas represented are roughly the same as in their relationships over much broader extent. It is believed that these five townships, representing but a tiny fraction of the area of this southern part of the state, are fair samples or cross-sections of a considerable part of the whole area. If this is true, the results obtained from the sample or type area may be applied with a considerable degree of accuracy over a much broader area.

As the term is commonly used in the north, there are no "wild lands" in southern Michigan. On the other hand, there are various types of essentially non-agricultural lands. These are classified into various types: (*a*) upland forest, (*b*) swamp forest, (*c*) brush swamps, (*d*) marshes (see Map 20 for details of legend). In the small part of the total area mapped, which has been analyzed to date, the combined total of these non-agricultural lands is 24 per cent of the total area. Such wild lands are of importance in providing cover for protection, food, nesting places, etc., for the various forms of wild life.

The fields of various crops are significant in relation to different birds and animals. They provide food, shelter and nesting places for various species. With this fact in view each field has been mapped and the particular crop of the year noted. The percentage of actual crop land in the area presented on Map 20 is 38 per cent.

For twenty years at least the actual amount of crop land in most of southern Michigan has been shrinking steadily. This gives rise to the third category or classification, permanent pasture and abandoned land, 34 per cent of the area mapped. The term "abandonment" indicates merely cessation of regular use for either crop or pasture, a common situation in this area, but not necessarily permanent. The growth of weeds, brush and the like on such fields gives food and cover of a desirable character.

It has been shown by analysis that the details of the land use

(Map 20) vary considerably with the character of the surficial geology, which to a considerable degree causes differences in soil and in land surface. Of the area under discussion, the extreme eastern portion, 27 per cent of the total area, is outwash plain. The central and southwestern portion, comprising 59 per cent of the area, consists of morainic deposits, while the northwestern portion, or 14 per cent, consists of till plain, much of which is poorly drained.

On the outwash plain, the major part of the acreage is devoted to crops. The almost level land surface, together with the calcareous sandy loam soil, undoubtedly accounts largely for this predominance of crop land. Wheat has by far the largest acreage, followed by oats and corn. During the year 1929 considerable acreage was left idle, but there was clearly no permanently abandoned land.

Much uncleared land is found in the portion underlain by morainic deposits and in the poorly drained till plain in the northwest. This uncleared land consists chiefly of swamp timber and scattered areas of other swamp types of vegetation; on the better drained lands several stands of upland timber are noted. The dominant crop is clover or timothy, with corn next in importance. Large areas of uncleared land remain abandoned or in permanent pasture. The character of land use in this portion of the area results largely from the fact that the surface as a whole is rough and rolling, with a coarse-textured, sandy loam soil. As is characteristic of morainic deposits, areas of poorly drained land are prevalent.

On the till plain in the northwest the proportion of the acreage in crops increases, except in the poorly drained parts. Here the land surface is gently undulating, with a soil similar to that of the outwash plain, but with crop associations closely allied to those of the moraines rather than to those of the outwash plain.

As outlined in part above, the inventory gives the actual areal extent of the cover types of all kinds which may be measured accurately. It shows decided differences from place to place and between variations in soil and surface. The actual classification of cover types used is, of course, merely tentative. It seems quite

probable that experience may show the value of further refinement. In addition, the maps reveal clearly the patterns of cover types, that is, the areal relationships between the various classes. Some sections are composed almost wholly of crop lands; in others the crop lands are distributed irregularly among wild land types. Such pattern is of major importance, especially to the wild life species which do not range widely.

The cover mapping, as carried out during the summer of 1929, makes no effort to appraise the wild life itself, either actual or potential. Such mapping is but the first step in the inventory. The next step is the inventory of wild life itself, in terms of the various cover characteristics and patterns which are illustrated here. Naturally this must, in turn, lead to the study of the relationships between the wild life forms and the environment, and between the forms themselves. The project, of course, is experimental in character. The coöperative efforts of various scientists are necessary to bring it to a logical conclusion. The scientific development of game management and the development of the game crop to a maximum appear to require such basic data as result from the completion of the inventory.

University of Michigan

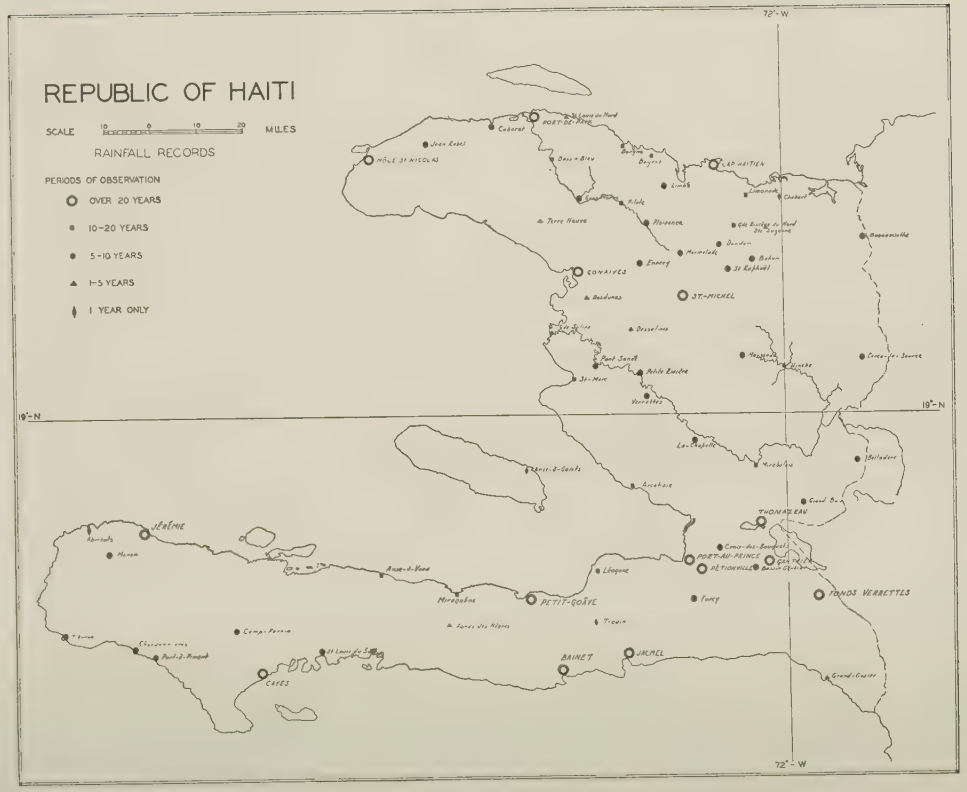
THE CLIMATES OF THE REPUBLIC OF HAITI

ROBERT BURNETT HALL
AND
HENRY MADISON KENDALL

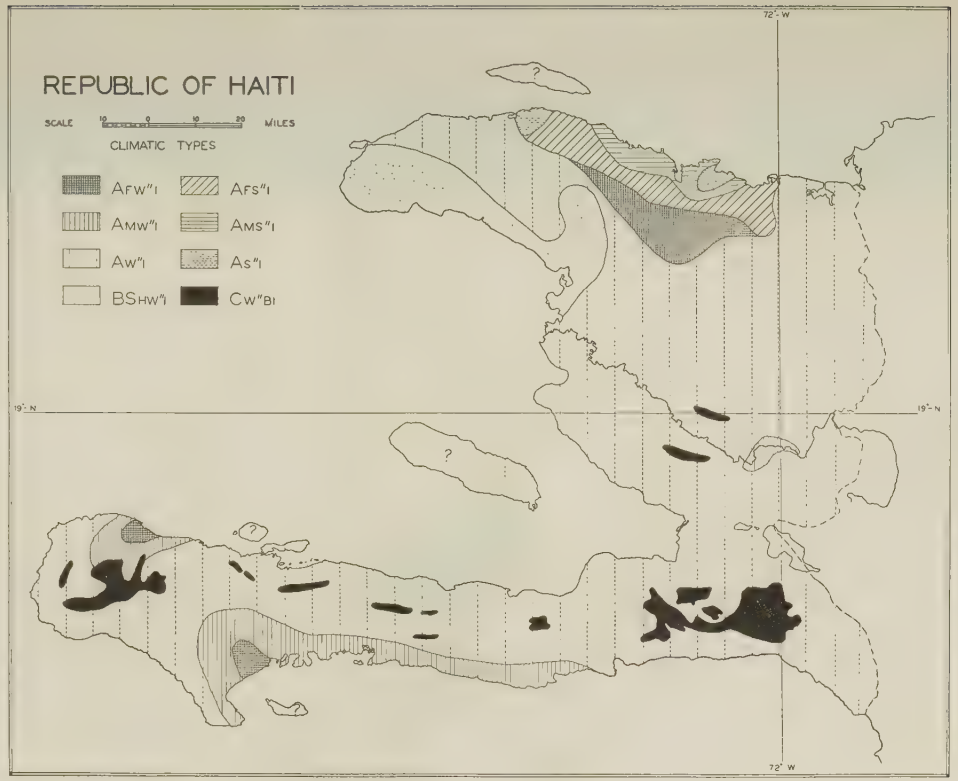
COMPLEXITY is expected in the climate of any mountainous island in the low latitudes, and the climate of the Republic of Haiti is no exception to this expectation. Hot rainy climates are usual within the tropics, especially on the east coasts of continents, but conditions of exposure, prevailing winds, altitude and local storms may alter specific conditions. Many types or variations of climate are found throughout in place of similarity. The Köppen climatic classification has been used in conjunction with a consideration of the cause of rainfall, to emphasize the distribution of the variations. With the plotting of the distribution of the types represented, an approximate explanation can be made of the various conditions which are found to exist in different parts of the country. It cannot be stated that any one condition is due to one cause. Each condition must rather be considered due to a complexity of causes. Some order can be made, however, of the variety of climatic types found in the Republic of Haiti.

Lying wholly within the tropics, the Republic of Haiti has the A division of the Köppen climatic classification over a large portion of its area. Next in importance areally is the B division, and, lastly, found only in the higher portions of the mountain chains, there are some areas which fall within the C division. There are several types of the A division found throughout the country, but, according to the statistics available, there is only one type of both the B and the C divisions.

On the north shore in the lowlands near Cap-Haitien and Port-de-Paix (Maps 21–22), there are two small areas the climate of


REPUBLIC OF HAITI
SCALE 10 0 10 20 MILES
RAINFALL RECORDS
PERIODS OF OBSERVATION
OVER 20 YEARS
10-20 YEARS
5-10 YEARS
1-5 YEARS
1 YEAR ONLY
72°-W
19°-N
PORT-DE-PAIX
CAP HAITIEN
GONAIVES
ST-MICHEL
PETIT-GOÂVE
PORT-AU-PRINCE
JÉRÉMIE
CAYES
BAINET
FONDS VERRETTES
THOMAZEAU

Map 21


REPUBLIC OF HAITI
SCALE 10 0 10 20 MILES
CLIMATIC TYPES
Afw"i
Afs"i
Amw"i
Ams"i
Aw"i
As"i
BSHw"i
Cw"Bi
72° W
19° N
19° N
72° W

Map 22

which is best represented by the symbol As″i.[1] Reaching inland from the area about Cap-Haitien is a section of country for which the symbol Ams″i seems best suited. Surrounding this and higher in elevation on the northern ranges is a belt in which the climatic type is Afs″i. This whole zone represents an area in which (1) the average temperature of the coldest month is never below 64.4° F.; (2) the range of temperature between the warmest and coldest months is less than 9° F.; (3) the rainfall increases inland and with elevation; and (4) the driest season of the year is the high sun period.

Over the crest of the northern mountain ranges, extending from about the longitude of Port-de-Paix eastward, there is an area the climate of which is best represented as Afw″i. It is similar to the climate of the northern slopes except that the longer dry season comes during the low sun period. Les Cayes and Jérémie and their immediate vicinities have this same type of climate. The average temperature of all months is above 64.4° F. There is a range of less than 9° F. between the coldest and the warmest months, and there are at least 2.4 inches of rain during the driest month.

Along the south coast and surrounding the region of Les Cayes the Amw″i climate is found. This is similar to the Afw″i type. The one difference is in the amount of rain during the driest month, which is slightly less than 2.4 inches.

The shore of the northern peninsula from north of Môle St. Nicolas to south of Gonaives and the area inland to the upper slopes of the mountains have the BShw″i climate. This section is subhumid, with a mean annual temperature over 64.4° F. and a yearly range of less than 9° F. The two maxima of rainfall occur in May and November; the winter months are very dry, desert rather than steppe conditions existing at that time.

On all the mountain areas above 4,750 feet elevation, Cw″bi conditions prevail. In this climate the coldest month is between 64.4° F. and 26.6° F.; ten times as much rain falls in the warmest month as in the coldest; the temperature of the warmest month

[1] See Köppen, W., *Die Klimate der Erde*, Berlin and Leipzig, 1923, for definition of symbols.

is under 71.6° F. and four months are over 50° F.; the yearly range is less than 9° F.

Throughout the rest of the island, Aw″i conditions prevail. All months have a temperature of over 64.4° F. There are two maxima of rainfall; the longer dry season is in the low sun period. In general, the first maximum of rainfall throughout the country comes in May; the second maximum varies from north to south, coming in November in the north and in October in the south. There are a few exceptions to this general statement, notably at Mirabalais in the interior, where the first maximum comes in May and the second in August. At Hinche, some twenty miles north of Mirabalais, the first maximum comes in May and the second in September. These differences in the periods of maximum rainfall may be ascribed, as may many variations of types of climate found in Haiti, to location with reference to mountains.

Rainfall statistics have been kept at Port-au-Prince for a period of forty-nine years and temperature and wind statistics have been recorded with accuracy for at least half of that period. The weather types at Port-au-Prince may be taken as representative of the Aw″i climatic regions throughout the island. Table I shows the weather types for the period from 1911 to 1923.

The criteria used in the determination of the weather types is as follows:

Temperature (daily mean)

Hot — 68° F. to 80° F.
Very hot — above 80° F.

Rainfall (daily total)

Clear — less than 0.01 inch
Rainy — 0.01 inch to 0.99 inch
Very rainy — over 0.99 inch

Wind

Calm — 0 to 9 m.p.h.
Windy — 9 to 19 m.p.h.

It will be seen from Table I that the most prevalent weather type is very hot, fair and calm; it prevails 50.6 per cent of the time. The type next in importance is very hot, rainy and calm, which prevails 20.5 per cent of the time. Following this, the most

TABLE I

OCCURRENCE OF WEATHER TYPES AT PORT-AU-PRINCE, HAITI (1911–23)

(Figures are percentages of total days)

Weather types	January	February	March	April	May	June	July	August	September	October	November	December	Longer dry season, Nov., Dec., Jan., Feb., Mar.	Shorter rainy season, April and May	Shorter dry season, June and July	Longer rainy season, Aug., Sept., Oct.	Year
Hot, fair, calm	52.3	40.5	17.8	13.3	4.4	1.5	0.7	0.2	0.5	3.7	19.7	41.1	34.3	8.8	1.1	1.5	16.2
Hot, rainy, calm	6.7	11.8	12.6	12.5	9.9	1.2	0.2	0.2	1.2	4.7	9.4	9.4	10.0	11.2	0.7	2.0	6.6
Hot, very rainy, calm	0.7	0.8	2.7	3.0	3.7	0.0	0.0	0.2	0.0	0.9	0.7	0.0	1.0	3.4	0.0	0.4	1.1
Very hot, fair, calm	35.7	37.0	49.3	42.3	46.1	63.1	72.2	64.2	25.6	52.8	49.2	44.6	43.1	44.1	67.7	55.8	50.6
Very hot, rainy, calm	4.2	7.6	14.1	22.5	29.8	24.8	23.5	29.5	38.2	31.5	16.9	3.7	9.2	26.3	24.2	32.9	20.5
Very hot, very rainy, calm	0.0	1.0	1.7	4.6	4.7	5.3	1.7	4.7	34.4	6.9	3.8	0.4	1.4	4.6	3.5	6.6	3.6
Hot, rainy, windy	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Very hot, rainy, windy	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Very hot, fair, windy	0.2	0.8	1.4	1.5	1.2	3.8	0.9	0.7	0.0	0.2	0.0	0.4	0.6	1.4	2.3	0.5	1.0
Fair	88.0	78.5	68.7	57.1	51.8	68.4	73.9	65.2	26.4	55.8	68.9	86.3	78.2	54.3	71.2	57.8	67.9
Rainy	10.9	19.6	26.7	35.1	39.7	26.1	24.2	29.7	39.5	36.2	26.4	13.1	19.2	37.5	25.2	35.8	27.2
Very rainy	0.7	1.9	4.4	7.7	8.4	5.3	1.7	4.9	34.1	7.9	4.6	0.4	2.4	8.0	3.5	6.2	4.7
Hot	59.8	53.4	33.2	28 9	18.1	2.8	1.2	0.7	1.7	9.4	30.0	50.6	45.4	23.4	2.1	4.0	24.0
Very hot	40.1	46.6	66.7	71.0	81.8	97.2	98.7	99.2	98.2	90.5	70.0	49.3	54.5	76.5	97.8	95.9	75.9
Calm	99.7	99.1	98.5	98.4	98.7	96.1	98.5	99.2	100.0	99.7	100.0	99.5	99.3	98.6	97.3	99.5	98.9
Windy	0.2	0.8	1.4	1.5	1.2	3.8	1.4	0.7	0.0	0.2	0.0	0.4	0.6	1.3	2.6	0.5	1.0

frequent type is hot, fair and calm, during 16.2 per cent of the time. The other types occur less and are of minor importance.

The percentage of fair, rainy and very rainy days in relation to the dry and rainy seasons gives a basis for comparison of these seasons. During the two dry seasons, 74.7 per cent of the days are fair, 22.2 per cent are rainy, and 3.0 per cent are very rainy. During the two wet seasons, 56.1 per cent of the days are fair, 36.7 per cent are rainy, and 7.1 per cent are very rainy. The longer dry season (from November through March) has the largest percentage of fair days. The shorter wet season (April and May) has the smallest percentage of fair days.

Very hot days are more common than are hot ones, and days with a mean temperature below 68° F. do not appear in the records. Very few days may be classed as windy (1.0 per cent); the shorter dry season (June and July) has more windy days than any other season.

Rainfall records (Table II) are plentiful. Twenty-eight stations with over ten years of record have been taken as the original basis. Twenty-seven stations with over five years of record offer a sufficiently reliable basis for further plotting of types. Many stations with less than five years of record can be found and these provide useful checks of both the climatic type and cause of rainfall. These stations, as a whole, are sufficiently scattered to cover all parts of the country in a fairly satisfactory manner.

Because of the low annual range of temperatures over the whole area, temperature records (Table III) are not so important as are the rainfall records. The existing temperature data extend over a relatively short period from three to seven years, and in one record there are data for the coldest and warmest months only, but they show with that exception sufficient constancy in all years to make it fair to assume that no individual excess or deficiency is present. Furthermore, with three exceptions, the records are for stations having ten years of rainfall record. These stations are well distributed along the seacoast. One exception is Furcy, located in the mountains south of Port-au-Prince. There the existing records show very nicely the expected lowering of temperature with the increase in altitude. For all other stations,

TABLE II

Rainfall (in Inches)

(Abbreviations used in last column: N = Northern province; W = Western; S = Southern; I = Interior)

Station	Source	Length of record in yrs.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Climatic types	Rainfall provinces
Bainet	I	24	2.09	2.07	4.35	8.22	8.63	4.40	3.85	5.01	6.36	6.61	4.50	1.85	57.94	Amw″	S
Cap-Haitien	I	23	4.20	4.01	3.53	3.11	5.02	2.88	1.39	1.53	3.90	8.21	8.21	3.92	49.93	As″i	N
Cayes	I	23	2.91	3.41	4.85	6.89	10.91	6.73	4.71	8.38	9.70	13.23	7.03	2.88	81.63	Afw″i	S
Fonds Verrettes	III	20	1.58	1.70	2.75	6.62	10.08	5.79	3.91	6.52	8.04	8.33	5.19	0.85	61.39	Aw″	S
Ganthiers	III	32	0.56	0.81	1.22	4.53	5.39	1.75	1.27	2.59	4.76	5.31	2.43	0.86	31.47	Aw″i	S
Gonaives	I	28	0.17	0.41	0.66	0.98	3.01	3.58	2.96	2.52	3.39	2.07	0.92	0.43	21.10	BShw″i	W
Jacmel	I	24	1.27	1.74	3.79	5.08	8.23	4.30	2.92	5.18	5.17	6.24	3.53	1.10	48.55	Aw″i	S
Jérémie	III	22	3.41	3.74	2.59	3.91	6.34	5.05	3.54	4.24	4.11	4.73	5.31	2.58	49.54	Afw″i	S
Môle St. Nicolas	I	25	1.36	0.88	0.87	1.21	2.02	2.87	1.04	1.36	2.70	2.28	2.57	1.56	20.72	BShw″i	W
Pétionville	III	37	1.02	1.90	3.55	7.43	8.28	4.26	3.28	5.08	7.75	6.53	3.13	0.98	53.15	Aw″i	S
Petit-Goâve	I	24	0.69	1.93	2.08	4.36	7.02	4.81	4.07	5.40	5.76	3.73	2.49	0.82	43.16	Aw″	S
Port-au-Prince	I	52	1.24	2.42	3.67	6.26	5.59	4.06	2.69	5.50	7.13	7.66	3.48	1.28	50.98	Aw″	S
Port-de-Paix	I	23	5.20	3.21	1.95	2.66	3.49	3.31	2.44	3.54	5.03	5.03	7.77	5.29	48.92	As″	N
St.-Michel	I	23	0.48	0.53	1.63	2.76	7.70	7.53	4.65	5.58	6.82	4.93	1.56	0.80	44.97	Aw″	I
Thomazeau	III	23	0.33	0.83	1.40	3.52	0.54	2.45	2.59	3.28	5.32	4.57	2.72	0.37	27.91	Aw″	W
Anse-à-Veau	III	19	1.69	1.70	2.06	3.78	6.15	4.76	4.65	5.75	4.08	4.02	3.10	0.90	43.05	Aw″	S
Arcahaie	I	19	0.72	1.04	1.82	2.50	5.31	3.54	3.20	3.59	4.20	3.82	2.56	0.79	33.09	Aw″	W
Bassin Bleu	I	17	1.13	1.39	1.05	2.35	4.77	3.93	3.25	4.39	4.51	3.85	4.02	1.76	36.40	Aw″	N
Bayeux	IV	17	6.94	4.36	4.35	7.62	8.11	3.95	1.81	3.71	5.66	8.56	15.81	11.49	82.64	Ams″	N
Borgne	III	16	6.48	5.31	4.46	6.35	5.42	3.64	2.31	2.70	4.20	8.04	12.55	7.22	68.62	Ams″	N
Gde. Rivière du Nord	I	16	2.64	2.37	3.13	3.22	6.89	3.17	2.59	4.31	6.34	5.77	7.61	3.95	51.99	Afw″	N
Hinche	I	12	0.39	0.63	1.13	4.69	8.87	7.95	7.46	5.82	8.53	7.92	0.83	0.33	54.53	Aw″	I
Léogane	I	15	0.70	2.00	3.17	5.71	7.46	4.42	4.08	6.01	5.89	4.37	2.84	1.76	48.41	Aw″	S
Limonade	I	12	3.39	3.64	3.34	3.94	8.31	3.20	3.11	2.84	6.13	6.63	9.80	5.55	59.88	Afs″i	N
Mirabalais	I	14	1.29	1.58	4.74	8.08	14.74	12.40	12.93	17.15	15.49	11.96	4.71	2.26	107.33	Amw″	I
Miragoâne	III	13	1.24	1.58	2.01	4.14	6.80	4.57	5.72	6.07	7.57	5.86	3.07	1.46	50.09	Aw″	S
Pilate	III	15	2.56	3.51	2.95	5.44	8.70	5.91	5.04	6.49	7.39	7.63	8.46	3.41	67.49	Afw″	N
St.-Marc	I	19	0.60	0.86	0.67	1.76	4.65	5.05	5.41	5.34	5.15	3.96	1.22	0.32	34.99	Aw	W

Bahon	IV	8	1.36	0.59	2.04	2.03	5.67	6.31	4.58	5.56	6.52	8.44	4.31	2.76	50.17	Aw″	N
Bassin Général	I	8	0.53	1.25	2.70	6.65	7.52	4.46	3.02	5.90	7.57	6.49	3.39	0.86	50.34	Aw″	S
Belladère	I	6	0.85	1.37	1.83	6.33	9.47	7.25	5.92	7.05	8.70	9.09	3.95	0.19	62.00	Aw″	I
Cabaret	I	5	0.89	0.36	2.50	1.82	4.75	3.78	4.77	4.39	5.20	3.69	2.44	0.32	34.91	Aw″	N
Camp-Perrin	I	7	2.10	3.58	4.87	4.94	6.63	8.06	5.64	11.48	11.92	15.08	10.25	2.83	87.38	Amw″	S
Cerca-la-Source	II	5	1.13	1.20	2.91	4.18	6.23	4.11	4.02	2.78	5.68	6.77	2.83	0.06	41.90	Aw″	N
Chardonniers	IV	9	0.76	2.61	2.97	4.70	3.00	1.91	1.93	3.72	5.36	6.82	3.52	1.09	38.39	Aw″	S
Croix-des-Bouquets	I	7	0.53	0.75	2.45	4.56	6.00	2.91	2.64	5.24	6.26	4.57	1.97	0.59	38.47	Aw″	W
Dondon	IV	9	2.43	1.61	2.54	4.20	6.52	4.57	4.00	3.97	5.29	6.62	6.88	5.47	52.10	Aw″	N
Ennery	I	9	0.91	0.58	0.93	2.17	6.46	5.72	4.21	5.12	7.16	5.85	3.22	0.52	42.85	Aw″	W
Furcy	I	7	1.25	2.46	5.07	7.48	15.10	10.08	8.13	12.05	25.39	14.77	6.97	0.32	108.07	Cw″bi	S
Grand Bois	I	9	0.91	1.07	2.48	7.17	7.18	4.83	4.78	8.74	6.82	7.12	5.06	0.88	57.04	Aw″	I
Gros Morne	I	9	0.44	0.91	0.71	2.01	4.59	3.52	2.34	2.56	4.13	3.05	1.70	0.42	26.38	BShw″	W
Jean Rabel	I	7	2.90	1.82	1.60	1.56	5.00	3.14	1.66	1.43	4.82	4.19	4.42	2.80	35.34	Aw″	N
La Chapelle	I	9	0.44	2.18	1.39	3.94	9.50	11.43	8.23	11.00	7.21	6.83	1.52	0.39	64.06	Aw″	W
Limbé	I	9	4.80	5.10	4.39	5.63	7.04	3.44	3.98	4.14	6.25	7.65	12.54	5.37	70.33	Afs″	N
Maïssade	II	6	0.56	0.79	1.37	4.20	11.32	10.19	8.24	3.74	8.14	9.76	2.29	0.42	61.02	Aw″	I
Marmelade	II	5	3.23	3.30	3.87	4.20	9.31	6.18	4.14	8.02	8.39	10.89	5.72	3.34	70.59	Afw″	N
Moron	IV	7	3.26	2.28	3.24	8.50	11.91	7.03	5.53	7.03	8.89	10.87	9.73	5.75	84.02	Amw″	S
Ouanaminthe	I	9	1.54	0.42	1.48	2.02	7.51	5.04	3.64	4.54	5.58	4.78	4.78	0.87	42.20	Aw″	N
Petite Rivière	I	9	0.37	0.51	0.90	2.20	5.85	9.50	7.28	7.83	7.33	5.68	1.24	0.53	49.22	Aw″	I
Plaisance	I	9	3.36	2.97	3.09	4.49	8.87	5.54	5.32	6.89	9.40	9.23	9.37	4.07	72.60	Afw″	N
Pont Sondé	I	8	0.55	0.57	0.85	1.46	4.47	5.79	3.90	6.15	5.00	3.52	1.26	0.06	33.58	Aw″	W
Port-à-Piment	I	6	0.77	1.31	1.78	2.29	1.23	2.78	2.83	7.76	31.32	10.89	4.97	1.16	69.08	Aw″	S
St. Louis du Sud	II	5	1.82	3.09	3.16	4.05	7.54	5.79	5.95	8.14	9.05	10.83	8.57	2.32	70.31	Amw″	S
St. Raphaël	II	5	1.23	0.75	1.28	2.16	4.22	3.74	4.04	2.88	5.29	3.34	1.51	0.30	30.74	Aw″	I
Verrettes	I	9	0.09	0.81	0.29	3.29	5.92	6.82	5.65	6.82	6.36	5.92	0.96	0.32	43.26	Aw″	I
Desdunes	II	2	1.00	0.09	0.09	0.05	2.64	2.61	2.09	3.40	7.56	11.68	2.62	0.00	32.83	Aw″	W
Dessalines	II	4	0.42	0.48	0.29	0.76	3.28	8.32	4.20	5.38	6.06	4.85	0.92	0.00	34.96	Aw″	W
Fondes des Nègres	I	4	0.92	0.78	4.90	3.49	5.41	3.31	3.69	13.94	5.36	6.44	2.15	0.99	51.38	Aw″	S
Grand-Gosier	II	3	0.86	1.73	2.78	4.78	8.23	6.53	8.58	7.48	12.46	12.26	4.50	0.38	70.57	Aw″	S
Grande Saline	II	4	0.16	0.02	0.34	1.67	4.07	3.76	4.49	9.39	5.10	1.52	1.89	0.64	33.05	Aw″	W
St. Louis du Nord	II	4	4.81	3.83	4.06	6.49	6.10	4.51	3.29	2.42	7.33	6.73	5.91	9.09	64.57	Afs″	N
Ste. Suzanne	II	2	5.65	5.00	7.82	2.65	8.12	2.91	4.17	2.68	5.51	6.65	1.67	1.30	54.13	Afs″	N
Terre Neuve	II	3	0.19	0.65	0.97	5.86	6.45	7.97	4.55	6.35	9.21	4.61	3.94	0.97	51.72	Aw″	N
Abricots	IV	1	0.95	0.89	2.32	1.96	4.14	1.87	1.89	0.83	2.32	1.57	3.43	2.19	24.36	Aw″	S
Anse-à-Galets	III	1	0.00	0.44	1.34	0.54	7.82	3.65	1.54	2.80	5.52	6.37	0.59	0.00	30.61	Aw″	
Chabert	III	1	3.70	0.60	1.37	0.00	7.96	2.26	3.90	1.18	3.44	2.74	13.18	3.20	43.53	Aw″	N
Trouin	III	1	0.63	1.77	0.83	3.66	10.43	0.87	0.28	15.24	9.68	7.32	4.47	0.00	55.18	Aw″	S

TABLE III

TEMPERATURE

Station	Source	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
Bayeux	IV	72.5	73.8	73.2	75.6	77.2	79.2	80.4	80.4	79.9	78.4	76.5	72.3	76.6
Cap-Haitien	IV	70.5	71.8	72.1	75.4	77.4	79.5	80.1	79.9	79.9	79.0	75.7	73.4	
	I	78.8	77.4	77.0	80.1	80.4	81.5	83.1	83.1	83.5	82.4	79.2	77.0	
	III	75.9	77.4	76.6	80.6	81.0	84.0	83.1	82.6	82.6	82.4	78.1	74.3	
		75.0	75.6	75.2	78.6	79.5	81.7	82.0	81.9	82.0	81.3	77.7	74.8	78.8
Cayes	IV	76.5	76.5	77.0	77.4	79.2	80.6	80.4	80.6	80.2	79.9	79.2	77.5	
	II	75.7	76.5	77.0	78.3	80.1	81.5	81.0	80.8	80.6	80.4	78.8	78.6	
		76.1	76.5	77.0	77.9	79.7	81.1	80.8	80.8	80.4	80.2	79.0	78.1	79.0
Fonds des Nègres	I	70.5	73.9	73.8	74.7	76.6	77.0	77.5	77.7	78.1	76.6	73.8	72.3	
	III	72.7	73.9	74.8	74.8	75.7	91.0	78.4	77.4	78.8	77.7	75.9	72.5	
		71.6	73.9	74.3	74.8	76.3	84.0	78.1	77.5	78.4	77.2	74.8	72.5	76.1
Furcy	IV	63.5	....	....	....	....	....	....	66.7	66.7	....	....	63.5	65.1
Ganthier	IV	75.2	76.6	77.7	79.3	81.1	81.7	82.2	82.2	81.5	80.8	78.8	76.3	79.5
Gonaives	IV	78.3	77.7	79.5	80.4	81.7	82.6	83.3	83.1	82.2	81.7	79.9	78.3	
	II	76.1	75.7	79.0	81.1	82.6	83.1	84.7	84.6	83.8	82.6	80.4	80.4	
		77.2	76.8	79.3	80.8	82.2	82.9	84.0	83.8	83.1	82.2	80.2	79.3	81.0
Jacmel	I	77.4	79.5	79.5	80.1	81.0	82.0	84.2	82.4	82.0	82.4	80.6	77.9	
	III	77.7	79.5	79.9	81.0	82.0	82.6	84.0	83.1	84.0	84.6	80.1	78.8	
		77.5	79.5	79.7	80.6	81.5	82.4	84.1	82.8	83.0	83.5	80.4	78.4	81.0
Jérémie	I	82.4	....	79.9	78.6	80.6	82.0	82.4	82.4	82.6	83.5	82.0	80.6	
Jean Rabel	III	71.2	70.5	73.2	76.1	77.9	80.1	81.1	79.5	80.8	80.6	76.1	72.0	76.6
Limonade	I	73.4	....	74.8	76.3	75.9	77.9	78.8	79.2	79.9	79.3	75.2	72.0	
	III	....	....	73.8	77.5	77.4	79.5	79.3	80.1	80.2	....	....	....	
		73.4	....	74.3	77.0	76.6	78.8	79.1	79.7	80.1	79.3	75.2	72.0	

Miragoâne	III	75.2	81.0	81.5	....	....	....	....	....	....	81.9	79.2	75.2	
Môle St. Nicolas	I	74.7	....	78.8	79.9	82.6	80.6	84.6	85.1	83.8	82.9	80.8	78.4	
Pétionville	IV	73.6	74.1	75.2	76.1	77.5	78.3	79.7	79.3	78.8	77.2	75.4	73.6	76.6
Port-au-Prince	IV	78.3	78.4	79.3	79.5	81.0	82.8	83.8	83.3	82.0	80.8	79.2	78.1	
	I	74.1	79.5	79.2	79.2	81.3	82.2	83.7	81.7	81.0	81.1	79.0	77.7	
	III	78.1	79.5	79.9	80.1	79.9	84.4	85.3	82.0	82.4	82.9	81.3	78.4	
	II	77.4	78.6	79.5	79.5	81.0	82.6	85.3	84.0	83.1	81.7	79.0	79.2	
		77.0	79.0	79.5	79.5	80.8	82.9	84.6	82.8	82.0	81.7	79.5	77.9	80.6
Port-de-Paix	IV	70.5	71.8	72.1	75.4	77.4	79.5	80.1	79.9	79.9	79.0	75.7	73.4	
	I	78.8	77.4	75.2	80.1	80.4	81.5	83.1	83.1	83.5	82.4	79.2	74.3	
	III	75.9	77.4	76.6	80.6	81.0	84.0	83.1	82.6	82.6	82.4	78.1	74.3	
		75.0	75.6	75.2	78.6	79.5	81.7	82.0	81.9	82.0	81.3	77.7	74.0	78.8
St.-Marc	I	80.6	78.8	75.6	76.3	79.2	79.2	76.8	....	....	83.1	87.8	78.8	
	III	80.6	78.8	79.3	84.2	83.1	84.6	86.5	86.0	82.6	87.4	86.7	80.6	
		80.6	78.8	77.5	80.2	81.1	81.9	81.7	86.0	82.6	85.3	87.3	79.7	81.9

SOURCES USED IN COMPILATION OF TABLES

Table I was constructed from material contained in the *Bulletin annuelle météorologique du Séminaire-Collège de St. Martial, Port-au-Prince.*

In Tables II and III the sources of material are as follows:

I. *Bulletin météorologique*, Direction Générale des Travaux Publics. Bureau de l'Ingénieur en chef, Haiti, 1929 (monthly).

II. *Report on Irrigation Possibilities in the Republic of Haiti.* Bureau of Public Works, Port-au-Prince, 1927.

III. *Bulletin hydrographique*, No. 6. Direction Générale des Travaux Publics, Port-au-Prince, 1928.

IV. Woodring, W. P., Brown, J. S., and Burbank, W. S., *Geology of the Republic of Haiti.* Port-au-Prince, 1924.

temperature was calculated from the nearest known station down valley, with allowance for lowering of temperature with increased elevation.

Everywhere throughout the Republic freezing temperatures are unknown. Along the coasts the mean annual temperature is about 80.1° F. It is warmest at St.-Marc, where it is 81.9° F., and coolest at Cap-Haitien and Port-de-Paix, where it is 78.8° F. In the interior there is a lowering of temperature of 1.8° F. for every 540 feet rise in elevation. Furcy, the only station maintained at a high elevation, has a mean annual temperature of approximately 65.1° F.[2] In most places the yearly range of temperature is less than 9° F. The daily range throughout is about 18° F.

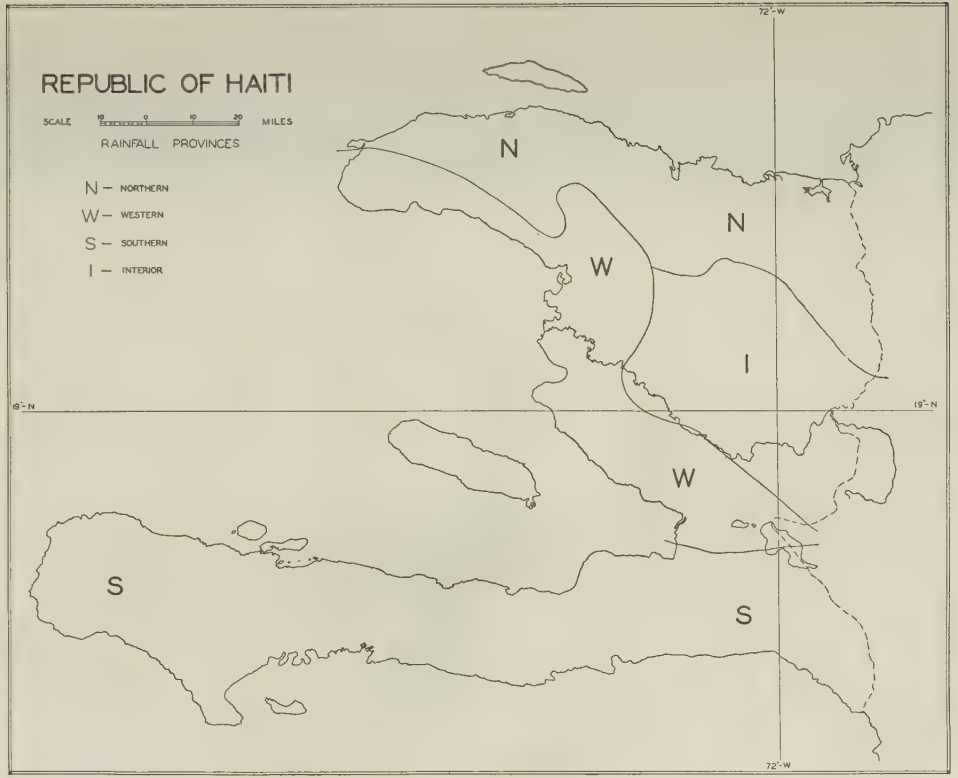
Within the Republic, it is possible to recognize four distinct rainfall provinces which emphasize some factors of régime of rainfall not expressed by the Köppen classification (Pl. LII). These provinces are the Northern, the Western, the Interior and the Southern (Map 23). This division has been made on the basis of régime and cause of rainfall.

Of all the provinces the Northern is most directly open to the influence of the Trade Winds. During the high sun period, these winds are nearly parallel to the coast and little rainfall is received from them. The protection of the north coast from the effects of the Trades is partially due to the presence of the promontory of Monte Cristi in the Republic of San Domingo. Rains in the high sun period are mostly due to high sun storms which are short and quite violent. During the low sun period, the Trades are best developed. This is the season of the "Nords," long, steady rains, which are more highly developed in this province than in any other.

The Western province is by far the driest of all the provinces. Rainfall is everywhere mainly the result of local storms which are short and often of excessive violence, accompanied by lightning, thunder and high winds. During the low sun period rain-shadow conditions prevail with decreasing effect to the south.

In the Interior province, both the maxima of rainfall occur within the high sun period. The local convectional storms are

[2] Woodring, W. P., Brown, J. S., and Burbank, W. S., *Geology of the Republic of Haiti* (Port au Prince, 1924), p. 40.


REPUBLIC OF HAITI
SCALE 10 0 10 20 MILES
RAINFALL PROVINCES
N — NORTHERN
W — WESTERN
S — SOUTHERN
I — INTERIOR
72°-W
19°-N
N
W
I
W
S
S
72°-W

Map 23

best developed, and the influence of the Trades during the low sun period is almost negligible. Intersecting valleys are the tracks of numerous short, violent storms. Mirabalais is typical of stations located at the intersection of several of the valleys; the influence of local thunderstorms on its climate is great.

In the Southern province the effect of the Trades is less than in others, but their influence is felt on the western extremity of the peninsula. Tropical hurricanes, especially violent on the south coast, and local convectional storms are the most important controlling factors of the rainfall.

Three characteristics are outstanding in the climate of the Republic of Haiti: the double maximum of rainfall throughout the area, the low annual range of temperature and the pronounced high sun period minimum of rainfall along the north coast. Double maximum of rainfall is not to be expected at such a distance from the equator. It does occur, however, in Haiti, and the occurrence is assumed to be mainly because of the strong development of the Trades in the late portion of the low sun period, and because of the intense development of the tropical hurricanes in the late high sun period. The low annual range of temperature may be laid mainly to the latitude of the island and its relation to the heat equator. The oceanic position of the area has the effect of emphasizing this characteristic. The high sun period drought of the north coast is largely the result of two factors, the prevailing winds and the peninsular character of the north shore of the island. In the high sun period particularly, the winds blow nearly parallel to the coast. There is no obstruction causing the rising and cooling of the moisture-laden winds, and there is only slight precipitation from them. Local storms account for most of the precipitation of this season. Some rain is brought by the occasional on-shore winds during the high sun period.

From the foregoing data it may be seen that there are four major controls of climate in Haiti: latitude, land surface, including exposure and altitude, prevailing winds and storm tracks. The Republic lies roughly between latitudes 20° and 18° north and between longitudes 71° 30′ and 74° 30′ west. The surface of Haiti might be classed as high relief, with a few scattered areas of low

relief, such as the sea border plains and the Plain Centrale. These plains are all separated by mountain chains rising in the northern peninsula to about 4,200 feet; in the central portion of the island to a slightly higher elevation; and in the southern peninsula to about 4,900 feet. Various isolated mountain crests and peaks rise well over 4,900 feet. The highest portion of any large area is in the eastern half of the southern peninsula, where the elevation reaches 8,792 feet. There are three main mountain chains: the northern range, which forms the northern peninsula nearly east-west in direction; the southern range forming the southern peninsula, which is nearly parallel to the range first mentioned; and two cross-ranges with a northwest-southeast direction between the northern and southern peninsulas. There are many minor ranges of mountains, but they may be considered as part of the major ranges. Throughout these mountains are innumerable pockets. Exposure plays the major rôle in the determination of their climates, but for many of these intermountain basins there are no available records, and exact information concerning their place in the Köppen classification cannot be given.

The island of which the Republic of Haiti is the western part lies midway from north to south in the northeast Trade Wind belt, where, because of the wide expanse of ocean to the east, these winds show their best development. The major axes of the island trend east-west. This trend of the land-mass lessens the full effect of the winds because of the tendency of the winds in those longitudes to be more directly easterly. Blowing from the Azores High, they continue to be deflected to the right to a greater extent as they progress farther westward over the Atlantic Ocean. When they have reached the longitude of the island, they have been so much deflected as to be more nearly from the east than from the northeast. It is also suggested that the seasonal distribution of average pressure conditions may make themselves felt in the change of wind direction in the various seasons. In January a belt of high pressure extends across the Atlantic with the median line about 30° north latitude. From this the winds blow outward and, with the normal tendency of deflection to the right of their course in the northern hemisphere, they assume more or less regularly

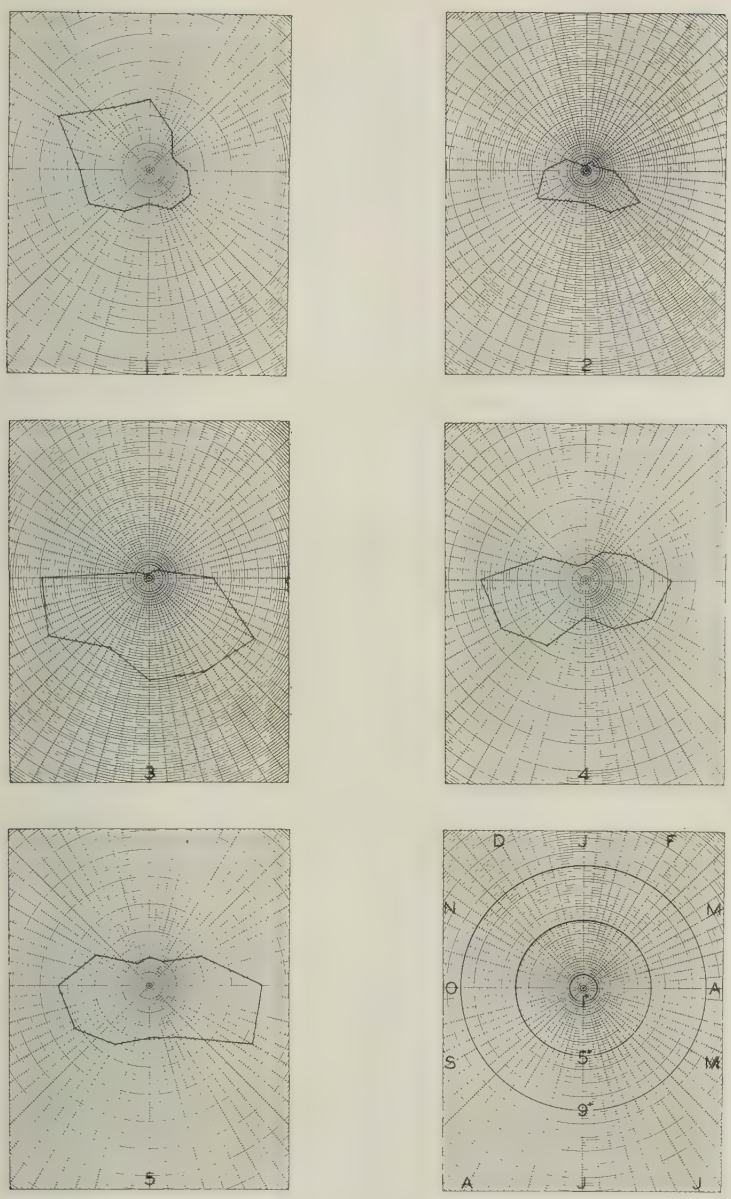
the direction suggested by their name. In July the belt of high pressure is broken, and the Azores High takes its place. At the same time, a belt of low pressure forms over western United States, extending from Mexico through northwestern Canada. The winds blowing from the Azores High follow their normal courses in the east Atlantic, but in the Caribbean area the effects of the low pressure trough are felt, and the winds are deflected until they become easterlies rather than northeasterlies.

The tropical hurricanes of the Caribbean area have a decided effect on the climate of the Republic of Haiti. The study of these hurricanes over a period of thirty-six years indicates their more frequent occurrence in the late high sun period months of August, September and October. O. L. Fassig writes: "Similar conditions are doubtless produced within the hurricane area of the West Indies by the advance of the North Atlantic high into the region of calms, or by the conflict between the opposing winds of the North and South Atlantic high areas, resulting in the formation of hurricanes, just as the advance and retreat of the high area over the southern Indian Ocean gives rise to the southwest monsoon and the squalls and cyclones over the Bay of Bengal." [3]

Variety is found in the climate of the Republic of Haiti. It may be explained in part by a study of climatic statistics, in part by an examination of the controls of climate within the area. The controls which have been mentioned are essential to any understanding of the climate of this mountainous island area within the tropics, although they do not completely explain it.

University of Michigan

[3] Fassig, O. L., *Hurricanes of the West Indies*, U. S. Dept. of Agriculture, Weather Bureau, Bulletin X, Washington, 1913.



Typical régimes of rainfall in the Republic of Haiti: 1, Port-de-Paix of the northern rainfall province; 2, Gros Morne of the western rainfall province; 3, Hinche of the interior province; 4, Port-au-Prince of the northern part of the southern rainfall province; 5, Bainet of the southern part of the southern rainfall province

AGRICULTURAL REGIONS IN MICHIGAN

ELTON B. HILL

MICHIGAN is a large state. It is a distance of about 400 miles from the northern tip of Keewenaw County to the southern edge of the state; from the extreme eastern to the western part of the state it is about 385 miles. Within this large area is found a wide variation in soil type and surface and climatic conditions. Largely because of these things, together with factors of an economic nature, Michigan farmers have found it advantageous to follow types of farming which vary quite widely within rather short distances. An understanding of the nature and extent of these variations should be of interest and value to geographers and others who desire to know more about the basic nature of the resources of the state.

The great diversity of crop and livestock production in Michigan has long been recognized. In 1914 Shaw [1] pointed out that Michigan was practically a self-supporting state with the exception of cotton, citrus fruits and rubber. The distribution of the different agricultural enterprises was shown by Church [2] in 1922. The grouping of these different enterprises into regions in which a homogeneous type of agriculture prevails is in accord with established geographical practice. In this study we have attempted to locate and delineate different agricultural regions in Michigan within which there are similar crop and livestock organizations and similar physical and economic conditions with respect to climate, soil type, topography, markets and price of land.

That a knowledge of the agricultural regions of the state is quite essential in the application of certain economic principles

[1] Shaw, R. S., *Michigan Agriculture, Its Present Status and Wonderful Possibilities, Michigan Exper. Sta. Special Bulletin No. 70.*

[2] Church, V. H., *Statistical Analysis of Michigan Agriculture,* Michigan Department of Agriculture, 1922.

to farming is evidenced by the work of this nature which is being done in other states and by the Bureau of Agricultural Economics of the United States Department of Agriculture. Spillman [3] has prepared an excellent treatise for the different types of farming areas of the United States. In 1928 bulletins relating to the agricultural regions of their states were published by North Dakota [4] and Massachusetts.[5] In 1929, similar publications were issued by Iowa [6] and by South Dakota.[7] Many other states have work under way leading to publications for the purpose of delineating and describing the different types of farming areas or agricultural regions within their borders.

METHODS AND SOURCES OF INFORMATION

This study by the Michigan Agricultural Experiment Station was in coöperation with the Bureau of Agricultural Economics, United States Department of Agriculture. Through the use of the 1925 census the counties which had a similar type of agriculture were grouped together. Then the 1922 Supervisor's Census made township data available which enabled us to cut through political boundaries. This rough outline map was then checked carefully with agricultural specialists at the Michigan State College and with farmers and county agricultural agents throughout the state. Either F. T. Riddell, co-worker on the project, or the author carried it for the purpose of checking in practically all the different regions. The result is the accompanying map (Map 24).

The line of separation between many of the regions is relatively quite distinct in that there is a significant change in the kind and amounts of crop and livestock enterprises within the range of a few miles. In other places the change from region to region was more gradual and less distinct. Some lines of demarcation are

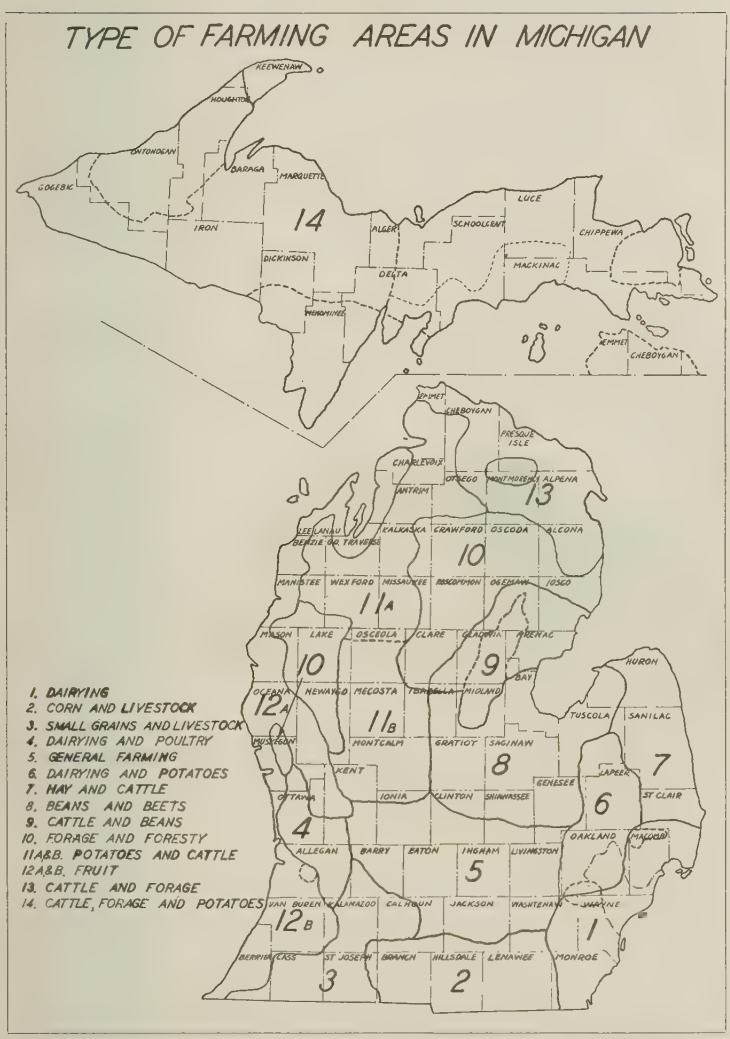
[3] Spillman, W. J., *Distribution of Types of Farming in the United States. U. S. D. A. Farmers' Bulletin No. 1289*, 1923.

[4] Willard, R. E., *et al., Types of Farming in North Dakota. Technical Bulletin No. 102.*

[5] Mighall and Brown, *Types of Farming Areas in Massachusetts. Bulletin No. 244.*

[6] Holmes, C. L., *Types of Farming in Iowa. Bulletin No. 256.*

[7] Rogers, H. R., *Types of Farming in South Dakota. Bulletin No. 238.*



Map 24. The outlines of the fourteen major agricultural regions of Michigan

still subject to debate and change, depending upon the emphasis placed on the individual farm enterprise.

The Regions

For practical purposes it is not desirable to account for the occasional small sections to be found in many regions which, owing to extreme variations in soil types, have a somewhat different type of agriculture. It is desirable to keep the number of regions as low as is consistent with the major types of farming areas within the state.

In Michigan's agriculture there are three basic crop enterprises, namely, dairy, hay and oats. These are found generally throughout the state, and the other enterprises are for the most part superimposed upon them. Thus the different regions were delineated on the basis of the variation from the average. Quite often the predominance of certain crops or livestock and physical conditions was the determining factor. At other times it was a matter of degree of intensity.

The causal factors of major importance in determining the different agricultural regions are considered to be: (1) physical, relating to climate, soil and topography; (2) economic, relating to transportation, distance to markets, kind of markets, market demand and price of land; (3) biological, relating to insect pests and the plant and animal diseases.

In this study the state was divided into fourteen major agricultural regions. The type of farming practiced was the main criterion in determining the outline for the different areas. A name was selected to represent the major agricultural enterprises found on the farms in each section.

Region 1: Dairying and Truck Crops

This is the specialized dairy and truck crop region of southwestern Michigan and is comprised of Monroe, Wayne and parts of the adjoining counties. In these counties the trend of both these enterprises has been upward for the past twenty years to a greater extent than it has in adjoining areas. Dairy cows and poultry are of major importance. Sheep and swine are not numerous except

in Monroe County. Corn, wheat and oats are the major field crops. Fruit is found in the northwest corners of Macomb and Wayne.

The predominance of this intensive type of agriculture is due to near-by markets and favorable soil conditions. In addition, the price of land and taxes are relatively high, which tend to force more intensive types of farming. The surface is level for the most part.

REGION 2: CORN AND LIVESTOCK

This region is composed of Lenawee, Hillsdale, Branch and portions of adjoining counties. The soil and climate more nearly approach "corn belt" conditions than in any other region in the state; thus we find corn an important crop with its usual complement of hogs, cattle and sheep. All grain crops do well, and wheat is the most important cash crop. Sugar beets are grown in the eastern part of Lenawee County. The steer-feeding sections center around Blissfield and the lamb-feeding sections around Clinton in Lenawee. Dairying has been increasing rapidly, especially in Branch and Hillsdale. Lenawee is one of the poultry centers of the state. About 90 per cent of the land was in farms in 1925.

REGION 3: SMALL GRAINS AND LIVESTOCK

This region comprises the counties of Cass, St. Joseph, most of Kalamazoo and Calhoun and the southwest corner of Barry. It is a small grain and general livestock section somewhat similar to Region 2, but with about one third less cattle and swine and one half less sheep per 100 acres of improved farm land. The major cash crops are wheat, rye and potatoes. Mint, onions and celery are minor crops. From 80 to 85 per cent of the land area was in farms in 1925.

The soils and topography are the major factors determining the type of farming. The soils are, for the most part, sands and sandy loams low in humus and medium to low in fertility and acid in reaction.

REGION 4: DAIRYING AND POULTRY

This region is comprised mostly of Ottawa and Allegan and parts of Kent and Muskegon counties. It is one of the most in-

tensive dairy and poultry sections of the state. Swine and sheep are not numerous. In 1925, corn occupied about 15 per cent of the crop area, wheat and rye about 13 per cent and oats 10 per cent. Truck crops, namely, celery and onions, are also of importance. There is much variation in soil types, from sands to clay loams. About 82 per cent of the land area was in farms in 1920.

REGION 5: GENERAL FARMING

This general farming region is based primarily on dairying, wheat and beans. It comprises all of Livingston, Ingham, Eaton, and most of Jackson, Barry, Clinton and Ionia counties. It is one of the largest areas in the state in which a similar type of farming predominates. The swine and sheep enterprises are also of much importance. Somewhat less corn is produced than is produced in Region 2 to the south. The topography varies from gently rolling to hilly. Thus on many farms will be found untillable pasture land which favors the dairy and sheep enterprises. From 80 to 85 per cent of the land area was in farms in 1925.

A combination of climate, soil, topography and marketing conditions determines the type of farming.

REGION 6: DAIRYING AND POTATOES

This region comprises part of Tuscola and most of Lapeer and Oakland counties. Potatoes are the leading crop. The major livestock enterprise is the dairy. Sheep, formerly of importance, have been decreasing since 1910. The number of hogs has been decreasing since 1920. Much tree fruit is found in the southern part of Oakland; beans are common in Lapeer and Tuscola. The topography is for the most part gently rolling to hilly.

In general, the soils are somewhat lighter than in the surrounding regions. The chief factors determining the type of agriculture are soils, topography and nearness to market.

REGION 7: HAY AND CATTLE

This region, commonly known as the "Thumb," comprises the northern portion of St. Clair, all of Sanilac County and the eastern part of Huron. Beef and dairy cattle, with hay and oats, pre-

dominate. Beans, wheat and chicory are of importance in Huron and in parts of Sanilac counties.

This region is well adapted to the production of hay and pasture. Hay has long been one of the main cash crops. Beef cattle production, which has been the major livestock enterprise, is now being replaced in some degree by dairy cows for the production of whole milk for Detroit. There are very few sheep and hogs, owing quite largely to the small acreage of corn. In 1925, about 85 to 90 per cent of the land area was in farms.

For the most part the topography is level. Heavy soils predominate and thousands of acres are seeded late in the spring because of inadequate means of carrying away the heavy rainfall. The major factors determining the type of farming are the soils, climate and markets.

REGION 8: BEANS AND SUGAR BEETS

This region, commonly known as the "Saginaw Valley," includes Saginaw, Gratiot and most of Bay counties, together with portions of all adjoining counties. The agriculture is dominated by beans, sugar beets, wheat and dairy cows. Other important crops are corn, hay and small acreages of rye, chicory, fruit and truck crops. Poultry and swine are important minor enterprises. In 1925 about 85 per cent of the land area was in farms.

This section in general is one of the better farming areas in the state. The climate, type of soil and markets are the major factors determining the type of farming.

REGION 9: CATTLE, SHEEP AND FORAGE

Gladwin, Arenac, most of Midland and part of Clare, Ogemaw and Iosco counties make up this region. Hay, cattle and sheep are the predominating agricultural enterprises. Corn and hogs are beginning to be of less importance as we go north in the state. The number of dairy cattle has been increasing for quite a number of years. More extensive types of farming are found in these counties. Farm land constituted about 40 to 55 per cent of the total land area in 1925.

The topography is level to rolling, and the soils are mostly

sands to sandy loams. The climate and the soil are the major factors determining the type of farming.

REGION 10: FORAGE AND FORESTRY

Crawford, Roscommon, Oscoda and portions of adjoining counties are included in this area.

This region has the lowest percentage of land in farms of any area in the Lower Peninsula. It is characterized by its light soils of relatively low fertility. Agriculture is limited, but what there is is based primarily upon cattle, mostly dairy and forage crops, hay and pasture. A number of sheep ranches are found in the better sections.

The lighter soils and short growing season are the major factors determining the type of farming. From 10 to 13 per cent of the land was in farms in 1925.

REGIONS 11*a* AND 11*b*: POTATOES AND CATTLE

This region is best known as the "potato region" of the state. It includes the west-central counties of the northern part of the Lower Peninsula. The extent of the area may be observed by a study of the map.

The enterprises which predominate are potatoes, hay, pasture and cattle. About one half of the cattle are dairy cows. Hogs and sheep are of minor importance. Dairy products are marketed mostly in the form of cream and sold on a butter fat basis.

Region 11*b*, with a somewhat longer growing season, has a greater proportion of its land in farms, 65 to 85 per cent, than has 11*a* with 40 to 50 per cent in farms.

The climate, soils and topography are the major factors determining the type of farming.

REGIONS 12*a* AND 12*b*: FRUIT

This area, long known as the "fruit belt," borders Lake Michigan. It includes a strip of land varying in width from one half to thirty-five miles, extending from the southern boundary of the state to the north line of Charlevoix County, a distance of approximately 300 miles.

In the southern portion, or in 12*b*, the production of the following fruits is of importance: apples, pears, grapes, peaches, small fruits (raspberries, blackberries, dewberries and strawberries) and truck crops. Considerable acreages of cantaloupes and tomatoes are grown in Berrien County. Apples are found quite generally throughout the entire region. An intensive peach section is found in a strip 5 to 15 miles wide bordering Lake Michigan. Grapes are found mostly in Van Buren, Kalamazoo and Berrien counties. Much general farming supplements the fruit end of the business.

In 12*a*, or the northern portion of the "fruit belt," cherries are of major importance, in addition to apples, peaches and raspberries.

In both these areas the major factors determining the type of farming are climate, soils and topography.

REGION 13: CATTLE AND FORAGE

This section is the tip of northeastern Michigan. It contains most of Cheboygan, Presque Isle, Montmorency and Alcona counties and all of Alpena County.

The predominating features of the farming are hay and forage combined with cattle, of which about one half are dairy cows. Owing to the short growing season, very little corn is grown. Potatoes are an important cash crop, although not to the same extent as in Region 11 to the west. Swine and poultry are of little importance. About 22 to 39 per cent of the land area was in farms in 1925, of which about 35 per cent was classed as crop land.

The climate, soils and lack of good markets largely determine the type of farming.

REGION 14: UPPER PENINSULA OF MICHIGAN

This region includes nearly one third of the land area of the entire state. Such a large section should normally be divided into several regions, but, owing to the limited agricultural development in some districts, the type of farming areas has not become so well established as in the Lower Peninsula. For this reason subregions have been designated on the map by dotted lines. In this section there are large tracts of timber and cut-over land.

Counties showing the greatest agricultural development are Menominee, Houghton, Chippewa and Delta, which have from 20 to 35 per cent of their land area in farms. In the other counties the amount of land in farms occupies from 4 to 10 per cent of the total land area.

Dairying and poultry are important livestock enterprises; hay, pasture, oats and potatoes are the major crop enterprises. Potatoes are the main cash crop. Sheep and hogs are handled only on a minor scale.

The factors determining the type of farming are climate, type of soil, topography and the distance from markets.

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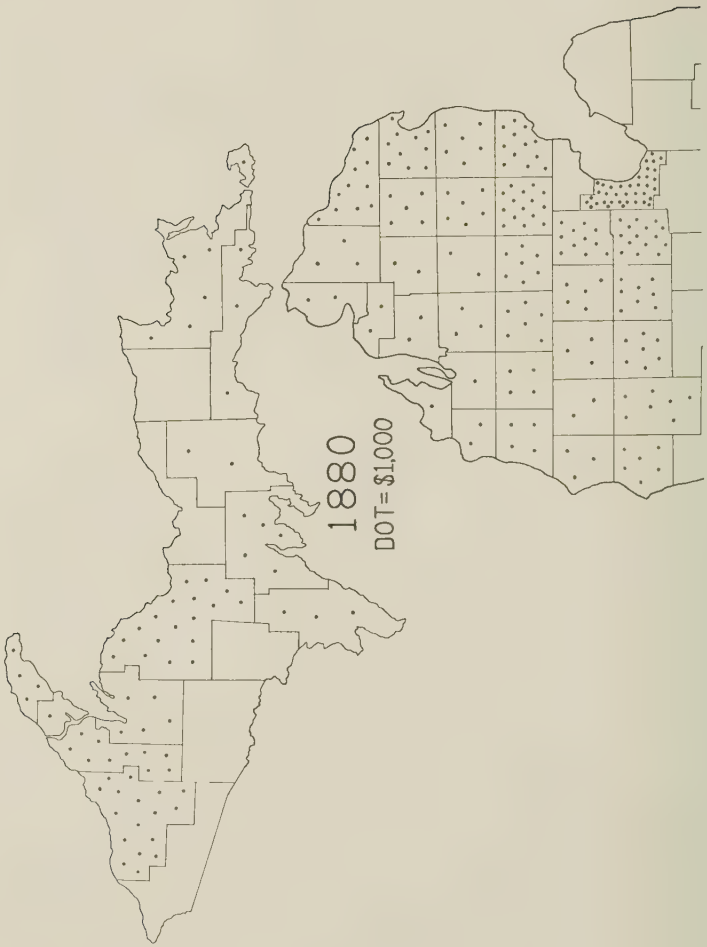
SOME GEOGRAPHIC RELATIONSHIPS OF TAX DELINQUENCY IN MICHIGAN

KENNETH C. McMURRY AND MARY GREENSHIELDS

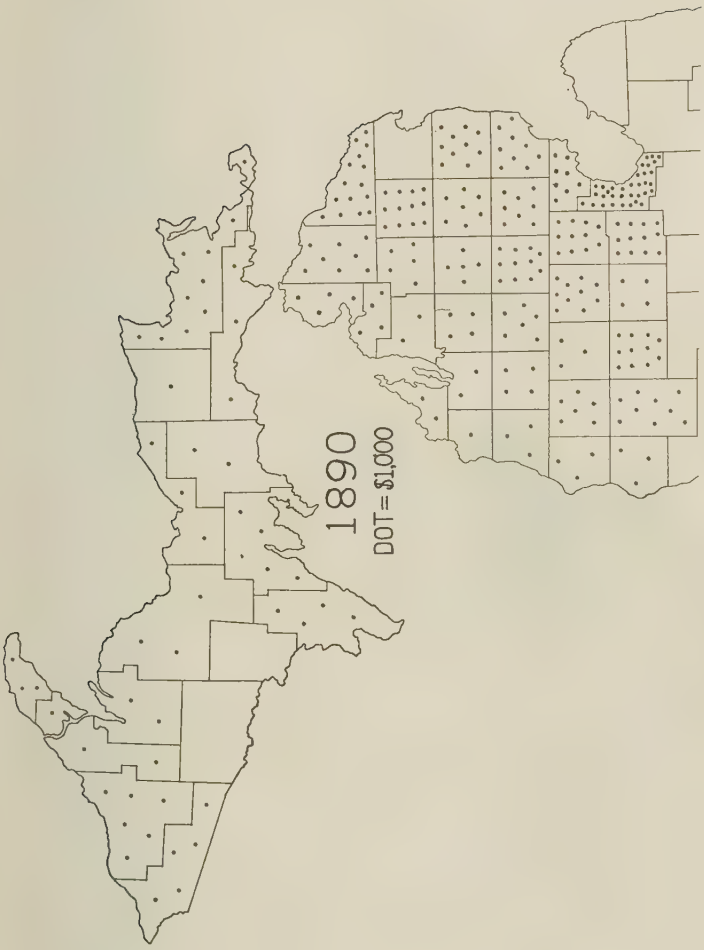
TAX delinquency, with the reversion of land to the state through this process, is a phenomenon of peculiar interest in Michigan at present. Ten years ago, as a result of a perusal of the Census of 1920 and comparison with earlier figures, it was discovered that the process of settlement in the northern part of the state had come to a halt, and at the same time it appeared that tax delinquency was on the increase.

During the past ten years the fact of increasing delinquency has become more and more apparent, and abandonment of cleared lands has increased, as shown by the work of the Land Economic Survey. Within the past five years the actual deedings of lands by the auditor general have doubled the acreage under the control of the Department of Conservation, until state holdings now exceed 1,600,000 acres, at least 10 per cent of the total wild land area of the north.

The historical background of tax delinquency in the state is of special interest in view of the present seriousness of the situation. A series of maps (Maps 25–30) indicates the stages through which the process has gone. It is apparent that tax delinquency is by no means a new problem in the state; it has been evident on a grand scale for fifty years at least. This set of maps is based upon the phrase "land bid to the state," which means land which has gone delinquent for three years, has been advertised for sale, has not been bought by private parties, and hence is said to be "bid to the state." At this stage such land is well upon its way toward state ownership. Some of it will be redeemed, some bought by individuals, but the penalties after three years are so high that the great bulk of such land automatically progresses the rest of

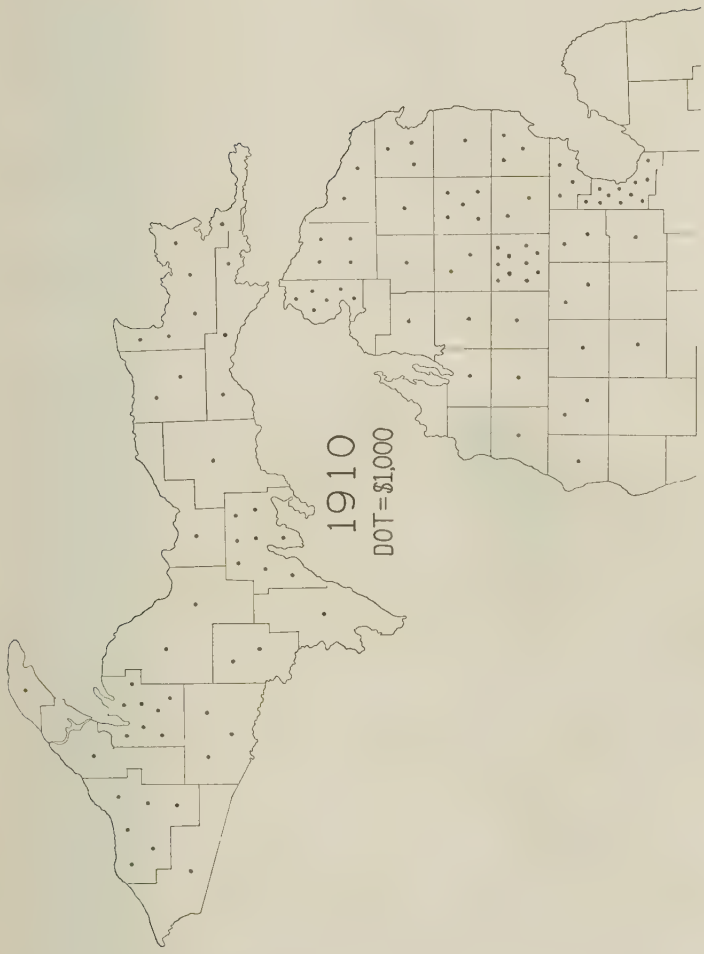


Map 25. Value of lands "bid to state" at annual tax sale, 1880

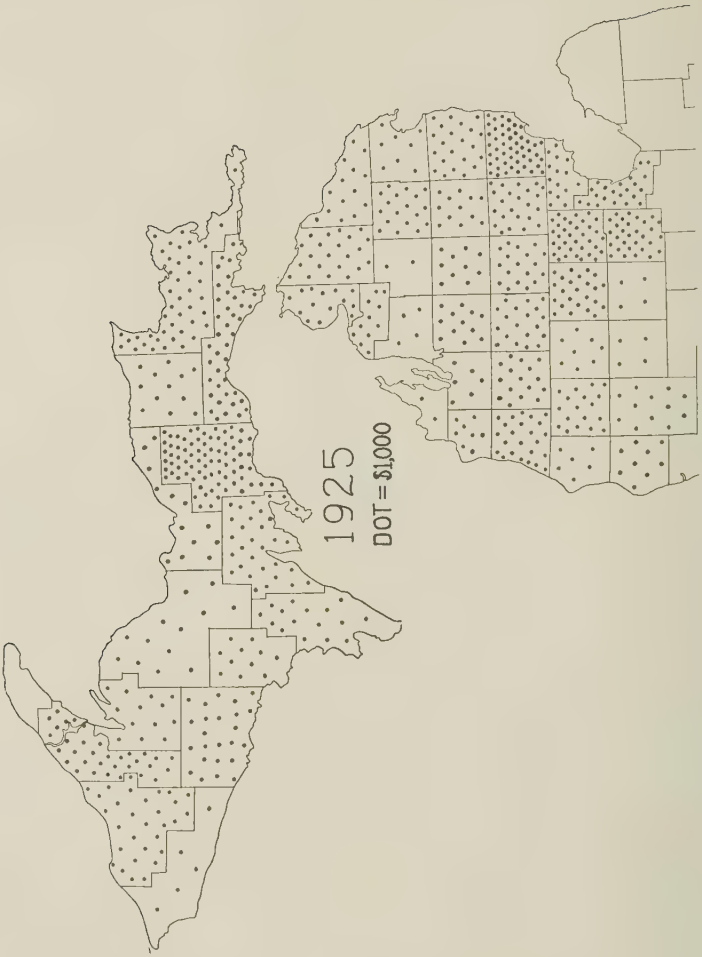


Map 26. Value of lands "bid to state" at annual tax sale, 1890

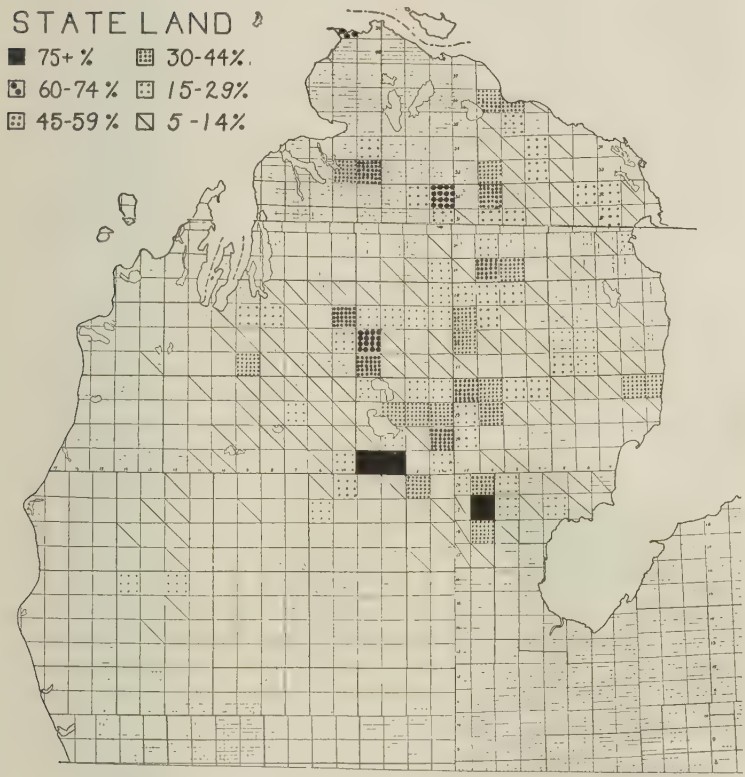
Map 27. Value of lands "bid to state" at annual tax sale, 1900



Map 28. Value of lands "bid to state" at annual tax sale, 1910



Map 29. Value of lands "bid to state" at annual tax sale, 1925



MAP 30. Amount of land owned by state in various sections

the way to state ownership. Inasmuch as the actual deeding of lands to the Department of Conservation has been irregular, and in the past has been made up only of the residue after every conceivable avenue of escape has been attempted by the auditor general, the "Lands Bid to the State," as published in the annual report of the auditor general, seems to be the best measurement of what has actually happened.

The maps, covering roughly ten-year samples, indicate some decided variations in amount and location of reversion during the

period from 1880 to 1925. Between 1880 and 1890 the amount of reversion was comparatively small, with a slight concentration in the Saginaw Bay tier of counties, then the area in which cutting of pine had been completed for some time. Between 1890 and 1900 there was a large extension of reversion to the northern counties of the Lower Peninsula and over the whole of the Upper Peninsula. This marks the cutting of pine and the final cleaning up of that business in most of the state. From 1900 to 1920 the amount of delinquency fell off surprisingly throughout the state; in fact, it appeared that the problem was well on the way toward solving itself. Only toward the end of the period did delinquency seem to be on the up grade once more.

This period marks the high point of agricultural settlement and of booming in the north. All kinds of land were cleared and settlement attempted. Most lands were considered as having potential agricultural value, and few were allowed to go delinquent. It took a considerable period of experiment, followed by many years of difficulty, before the futility of agricultural attempts in much of the area was generally realized.

That such a realization finally did come is shown in the reversion situation after 1920. The 1925 map indicates an enormous increase in delinquency in much of the area, and subsequent events have shown that the increase is still mounting. It is almost impossible to determine to what extent reversion may go in time, for there are several unmeasurable factors, but it is certain that for some years at least state lands will increase largely in volume through this process.

Map 30 indicates the percentages by townships now in actual state ownership, and includes small acreages of purchased lands, as well as those which have reverted.

The surprising fact is that no more land has actually come into state ownership during this long period in which reversion has been going on at either a slow or a rapid rate. It must be borne in mind that the main idea throughout this period had been to get all lands back on the tax rolls, and many and devious methods have been employed in this effort. In the earlier days "clean-up sales" were held, in which lands which could not be disposed of

otherwise were sold by description, in some cases at a few cents per description. Other public sales have been held from time to time, and it has only been the wholly unsalable lands which in general have remained in state ownership. In view of the fact that the state forests, game refuges and public hunting grounds in large part are and must be located in the areas of excessive reversion, a study of the geographic character of such lands becomes of significance.

In the Lower Peninsula Roscommon County contains the largest percentage of state lands, almost wholly acquired through reversion. The two townships in the southwest corner of the county are blocked almost solidly in the state forest, and in nearly all the other townships an appreciable percentage of state land is present. It is not by chance that this county contains the largest area of state lands in lower Michigan. Its assessed valuation is the lowest in the state, and in soil and cover it averages a low level, at least in terms of present money values. There is, however, a considerable variety of soil conditions in the county. Soils range through a series of sands through sandy loams into loams, and there is a very broad distribution of swamps. Swamp-border soils are also represented. Actual analysis of state and private ownership, when correlated with the main soil classes, suggests something of the qualities represented in this region in state holdings. Of the sands the state owns 35 per cent; of the sandy loams, which perhaps offer the hope of agriculture, only 15 per cent is in state ownership. The state owns less than 1 per cent of the loam soils, lands which are actually capable of use for crops. The state's percentage rises to 25 for the swamp and marsh-border types, and back to 35 for the swamps, the same figure as for the sands. Since swamp and sand types of soils dominate the area, it may be said that practically all state lands in the county are either sand or swamp.

The lands of highest value in Roscommon County are those which front upon the lakes, Houghton, Higgins and St. Helens. Of the extensive mileage of water front present in this county in which reversion has been most active, only one forty-acre tract represents the state's accumulation of frontage. While in the past

many descriptions undoubtedly reverted to the state on these lakes, only this tract has kept out of private ownership.

In the adjoining county of Ogemaw, in which agriculture has developed to a high degree for this general region, state-owned lands are made up of 75 per cent sands, 17 per cent sandy loams, 6 per cent swamp and the other 2 per cent miscellaneous types. No appreciable amount of the extensive area of loams has reverted. Much the same situation is indicated for Alpena County, where the state lands are made up of 26 per cent sand, 26 per cent swamp, 26 per cent marsh border, with the remaining 22 per cent largely stony and miscellaneous soil types. The accurate and detailed data for Roscommon have been measured from the soil maps of the Land Economic Survey and have been carefully prepared. The data for Ogemaw and Alpena are from the same source. Field observations, without definite quantitative measurements, in Oscoda, Montmorency, Grand Traverse and Crawford counties indicate that much the same relationships hold for state lands in these areas. Probably the only marked departure will appear in a lower percentage of swamp types in these counties as compared with Roscommon and Alpena. It is safe to generalize for the Lower Peninsula on this basis that the state lands are made up almost wholly of the very lowest grades of soil, and that practically no soils of good quality are included.

In Roscommon County an analysis of cover relationships indicates some interesting conditions. The most extensive cover type is poplar, of which the state owns 40 per cent. Next in importance is oak, with 45 per cent in state ownership. Fifty-five per cent of the jack pine is on state lands, while the swamp hardwood percentage drops to 26. Cedar on state lands is 30 per cent of the total; spruce, 70 per cent, and alder-willow 40 per cent. It is interesting to note that of the marches, mostly about the large lakes, the state owns but 16 per cent. On the other hand, more than 90 per cent of the white and Norway pine belongs to the state, a fact explained by the plantations on the state forest.

These percentages probably do not mean a great deal when applied to Roscommon County alone. It is evident that the amount of commercial timber present in the county is negligible,

and that, therefore, no sharp contrasts are to be expected. On the other hand, the dominance of poplar, oak and jack pine seems to be characteristic of state-owned lands generally and indicates that on such lands stumpage values are non-existent.

These generalizations hold in the estimates for state land in Ogemaw County also. The three major types appear there as follows: oak, 42 per cent; jack pine, 35 per cent; and poplar 23 per cent of the total area of state land. No other associations are sufficiently represented areally to be noted.

Under the different climatic and ground water conditions of Alpena County a rather different set of cover conditions prevails. Of the total area of state lands 63 per cent is poplar, 12 per cent coniferous swamp, and 12 per cent hardwood swamp. The rest is made up of plantations and miscellaneous associations. The situation, therefore, is not strictly comparable with that in Roscommon and Ogemaw, but the high percentage of non-merchantable types brings out the same general correlation.

As a generalization for lower Michigan, it may be said that in terms of soil the state lands are made up primarily of sands and peats, with some sandy loams and marsh-border types. No high grade soils are involved. Similarly, the cover types are primarily oak, jack pine and poplar, with smaller acreage of swamp types. No commercial timber of consequence is involved. Only the poorer qualities are present in state lands. With growing reversion, and especially with lands now coming back strongly in the Upper Peninsula, further correlations should be made, for the policies of the Department of Conservation in administration of state lands must depend primarily on the qualities of soil and cover present therein.

University of Michigan

WEATHER TYPE FREQUENCIES AT SAULT STE. MARIE, MICHIGAN

CLIFTON L. RAY

THIS paper presents the climatic characteristics of the city of Sault Ste. Marie, Michigan, which is located at the eastern end of the Upper Peninsula (lat. 45° 30′, long. 84° 21′) on Saint Mary's River at the outlet of Lake Superior. Its elevation above mean sea-level is 614 feet. Thermometers at the weather station are at an elevation of 11 feet above the ground. The anemometer is on a tower at a height of 52 feet above the ground. Observations at the stations were first made on August 5, 1877, and daily records have been kept continually since that date.

The official records of the U. S. Weather Bureau from 1907 to 1926, inclusive, have been used as the basis of the several tables and charts, but the averages of maximum, minimum and mean temperature and mean monthly rainfall (Table II) are for a somewhat longer period.

In the arrangement of the data the temperature, humidity, degree of cloudiness or sunshine, and wind velocity have been grouped and the frequency of their simultaneous occurrence calculated for the several months and seasons. Brief comment has been made upon the prevailing types of weather occurring in the twenty-year period. The method of treatment was suggested by E. S. Nichols' "Classification of Weather Types," *Monthly Weather Review*, October, 1925 (see Table I). The marked difference that is so frequently noted in the effect of high temperatures, depending upon both the relative humidity and the amount of air movement, and, in like manner, in the effect of low temperatures when occurring with an area of dry atmosphere and calm conditions or with damp air and high winds, illustrates the desirability of giving

TABLE I

Weather Type Classification

(after Nichols)

Temperature			*Humidity*		*Sunshine*		*Wind*	
T_{+2} (hot)	85° to	95°	H_{+2} (damp)	85 to 100%	S_2 (clear)		W_0 (light)	0 to 9 miles per hour
T_{+1} (warm)	75° to	84°	H_{+1} (humid)	75 to 84%	S_1 (partly cloudy)		W_1 (moderate)	10 to 19 miles per hour
T_0 (moderate)	60° to	74°	H_0 (moderate)	50 to 74%	S_0 (cloudy)		W_2 (strong)	20 or more miles per hour
T_{-1} (cool)	40° to	59°	H_{-1} (dry)	30 to 49%				
T_{-2} (cold)	20° to	39°						
T_{-3} (very cold)	0° to	19°						
T_{-4} (frigid)	−20° to	−1°						

TABLE II

Monthly Mean, Mean Maximum and Minimum Temperatures, Sault Ste. Marie, Michigan

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Maximum	22°	21°	32°	43°	59°	70°	74°	71°	64°	52°	38°	27°
Minimum	6	3	14	29	39	48	53	53	47	38	27	15
Mean	14	13	22	38	49	59	64	62	56	45	32	21

due weight to all those controlling factors that make up the day-to-day weather as we experience it. (See Fig. 10.)

The prevailing weather type at Sault Ste. Marie in the months of December, January and February has an afternoon maximum

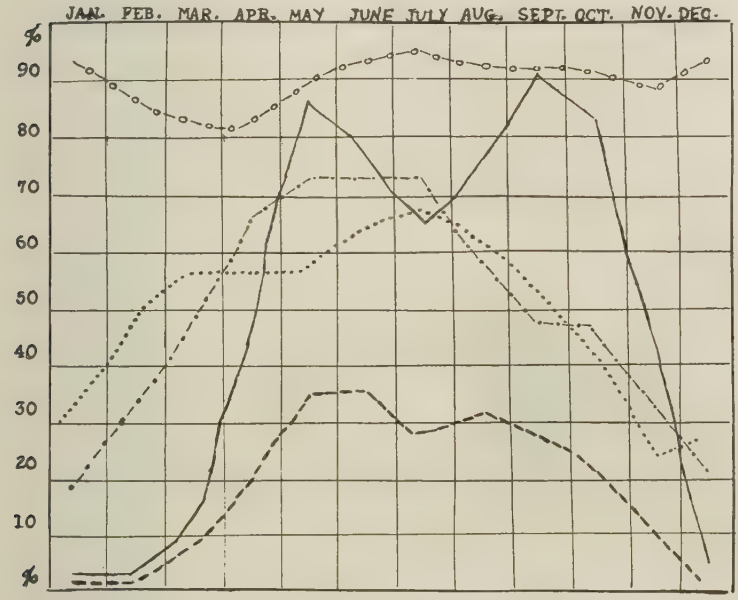


Fig. 10. Percentage frequency of weather types at Sault Ste. Marie

–o–o–o– Wind velocity light to moderate
. . . . . Clear to partly cloudy sky
·–·–·–·– Humidity moderate to dry
———— Temperature moderate to cool
·------ Simultaneous occurrence of types shown

temperature ranging between 20° and 39° ('cold'), accompanied by a cloudy sky, light to moderate wind velocity and humid to damp air (humidity from 75 to 100 per cent; see Table III). This group accounts for 39 per cent of the days in December, 30 per cent in January, and 23 per cent in February. The second most frequent winter type has a temperature of 0° to 19° ('very

TABLE III

Percentage of Frequency of Weather Types, Sault Ste. Marie, Michigan

Temperature — Wind — Humidity — Sunshine	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
T_{-4} H_{+1} H_{+2} W_0 W_1 S_0	2.7	0.4	....	....	....	....	....	....	....	....	....	0.8
H_0 $H_{\ 1}$ W_0 W_1 S_1 S_2	4.2	1.5	....	....	....	....	....	....	....	....	....	0.7
H_{+1} H_{+2} W_3 S_0	0.2	....	....	....	....	....	....	....	....	....	....	....
H_0 H_{-1} W_3 S_1 S_2	....	1.0	....	....	....	....	....	....	....	....	....	....
H_{+1} H_{+2} W_0 W_1 S_1 S_2	3.1	3.4	0.2	....	....	....	....	....	....	....	....	1.4
H_0 H_{-1} W_0 W_1 S_0	0.5	0.2	....	....	....	....	....	....	....	....	....	....
T_{-3} H_{+1} H_{+2} W_0 W_1 S_0	25.5	13.3	3.4	....	....	....	....	....	....	....	1.3	16.5
H_0 H_{-1} W_0 W_1 S_1 S_2	4.6	12.9	5.8	0.5	....	....	....	....	....	....	1.1	5.3
H_{-1} H_{+2} W_3 S_0	1.5	2.9	1.2	....	....	....	....	....	....	....	0.2	1.9
H_0 $H_{\ 1}$ W_3 S_1 S_2	....	0.7	1.1	0.7	....	....	....	....	....	....	....	....
H_{+1} H_{+2} W_0 W_1 S_1 S_2	14.5	15.2	3.6	....	....	....	....	....	....	....	0.6	6.5
H^0 H_{-1} W_0 W_1 S_0	3.4	2.8	2.4	....	....	....	....	....	....	....	0.4	2.4
T_{-2} H_{-1} H_{+2} W_0 W_1 S_0	28.6	23.2	20.1	11.2	2.5	....	....	....	....	5.9	32.8	38.9
H_0 H_{-1} W_0 W_1 S_1 S_2	3.1	6.6	18.9	12.8	1.5	....	....	....	....	1.4	7.8	5.3
H_{-1} H_{+2} W_3 S_0	2.7	2.7	5.2	3.3	1.8	....	....	....	....	0.8	4.8	4.3
H_0 H_{-1} W_3 S_1 S_2	....	0.4	4.0	5.7	1.7	....	....	....	....	0.4	0.3	0.3
H_{+1} H_{+2} W_0 W_1 S_1 S_2	3.3	4.4	9.2	2.0	0.5	....	....	....	....	1.4	3.9	6.4
H_0 H_{-1} W_0 W_1 S_0	1.6	3.8	7.7	4.2	0.9	....	....	....	....	3.4	8.9	5.2
T_{-1} H_{+1} H_{+2} W_0 W_1 S_0	0.2	0.2	2.8	11.6	14.1	9.9	2.0	3.6	13.3	25.3	16.1	2.7
H_0 H_{-1} W_0 W_1 S_1 S_2	....	0.2	7.3	26.3	16.9	5.9	2.0	2.7	8.4	15.4	5.2	0.2
H_{-1} H_{+2} W_3 S_0	0.2	....	0.2	0.5	1.2	0.5	1.8	1.9	2.5	2.8	2.0	0.3
H_0 $H_{\ 1}$ W_3 S_1 S_2	....	....	0.4	2.4	4.3	3.4	0.7	0.6	1.5	2.2	0.7	0.2
H_{+1} H_{+2} W_0 W_1 S_1 S_2	0.2	0.2	1.7	1.7	1.1	1.2	0.7	1.6	3.6	7.1	2.9	1.2
H_0 H_{-1} W_0 W_1 S_0	0.2	....	2.0	6.5	11.0	2.8	0.7	0.5	5.7	12.7	3.7	0.2
T_0 T_{+1} H_{+1} H_{+2} W_0 W_1 S_0	....	....	....	0.4	4.6	9.8	15.8	21.0	19.9	4.4	0.4	....
H_0 H_{-1} W_0 W_1 S_1 S_2	....	....	0.5	3.8	26.5	44.9	50.1	45.9	23.4	7.2	....	....
H_{-1} H_{+2} W_3 S_0	....	....	....	....	....	0.5	0.2	0.7	....	....	....	....
H_0 $H_{\ 1}$ W_3 S_1 S_2	....	....	....	0.2	0.8	1.5	2.1	0.4	0.7	....	....	....
H_{+1} H_{+2} W_0 W_1 S_1 S_2	....	....	....	0.4	1.3	4.8	7.5	9.0	11.1	5.0	....	....
H_0 H_{-1} W_0 W_1 S_0	....	....	....	....	4.7	9.1	10.0	10.0	4.8	1.7	....	....
T_{+2} H_{+1} H_{+2} W_0 W_1 S_0	....	....	....	....	....	....	0.2	....	....	....	....	....
H_0 H_{-1} W_0 W_1 S_1 S_2	....	....	....	....	....	2.2	5.8	1.8	0.5	....	....	....
H_{-1} H_{+2} W_3 S_0	....	....	....	....	....	....	....	....	....	....	....	....
H_0 H_{-1} W_3 S_1 S_2	....	....	....	....	....	....	0.2	....	....	....	....	....
H_{+1} H_{+2} W_0 W_1 S_1 S_2	....	....	....	....	....	....	....	....	....	....	....	....
H_0 H_{-1} W_0 W_1 S_0	....	....	....	....	....	....	0.2	0.2	....	....	....	....

cold') and other factors as in type 1; this group makes up 16 per cent of December days and 26 per cent of those in January. In February the secondary frequency (15 per cent) is as stated above, except that the degree of cloudiness is 0.0 to 0.7 in place of 0.8 to 1.0, that is, clear to partly cloudy instead of cloudy. Based upon these values December averages 12 days of 'cold' and 6 days of 'very cold,' accompanied by an overcast sky and light to moderate wind. January averages 8 days of cloudy and 'very cold' weather, 9 days cloudy and 'cold,' 4.4 days clear and 'very cold,' 1.3 days 'frigid' (subzero) and clear, and 0.8 day 'frigid' and cloudy. In February relative values are largely in agreement, with the exception of a marked increase in the amount of effective sunshine.

In March we have a further gradual decrease in cloudiness with 15 days either clear or partly cloudy. The two most frequent types of weather for this month are 6 days of 'cold' with cloudy sky, light to moderate wind and humid to damp air, and 5.7 days having a like temperature, clear to partly cloudy sky and moderate to dry humidity. Four days and a part of another are 'cool' (40° to 59°). Some increase in wind velocity is to be noted with four days having an hourly rate of movement over 20 miles. In April 26 per cent of the month (7.8 days) is 'cool,' accompanied by clear to partly cloudy sky, light to moderate wind and moderate to dry humidity; 13 per cent (3.9 days) is 'cold' and clear or partly cloudy; 23 per cent (6.9 days) is 'cool' to 'cold' weather with cloudy sky. In May there is a predominance of 'cool,' 'moderate' and 'warm' days, accompanied by clear to partly cloudy sky, accounting for 13.3 days; only 5.9 days were cloudy in the same group. Less than 3 days of 'cold' weather is the average in May.

In June, July and August there is a prevalence of 'moderate' to 'warm' temperatures with clear to partly cloudy sky, light to moderate wind movement and a moderate to dry humidity, averaging between 14 and 15 days a month through the season. The influence of the comparatively cool waters of Lake Superior upon the summer temperatures is well exampled at Sault Ste. Marie. During the latter part of the season the frequency of cloudy skies

increases somewhat, August averaging 37 per cent overcast as compared with 30 per cent in July and 32 per cent in June. The wind movement is comparatively light at this season, with 90 per cent of all days having a velocity under 20 miles per hour. Only a small percentage of the summer days are 'hot' (85° to 95°), July averaging slightly more than one day out of the thirty-one and June and August together accounting for one more.

In September 'moderate' to 'warm' conditions continue, representing 18 days as compared with 12 days of 'cool.' Fifty per cent of the month is cloudy and 43 per cent is of moderate to dry humidity. Of October 18 per cent is 'moderate' to 'warm.' The greatest frequency, however, representing 25 per cent, has a temperature of 40° to 59° ('cool') and cloudy sky, humidity between 75 and 100 per cent and light to moderate wind movement; 22 per cent is also 'cool,' but with clear or partly cloudy sky. During October the first 'cold' days of the autumn are recorded (upon mid-afternoon observations) representing 13 per cent of the month, or approximately 4 days. More than 50 per cent of the month is marked by cloudy skies. In November there is an average of one day of 'very cold' weather (0° to 19°), eighteen days 'cold' and eleven days 'cool.' There is also some increase in cloudiness, 21 days being overcast as compared with 17 in October.

A résumé of the seasonal weather might be stated as follows: 33 per cent of all observations during the spring months show a temperature defined as 'cool' to 'cold,' with clear to partly cloudy sky, light to moderate wind and moderate to dry humidity; 10 per cent represent a similar condition with the substitution of 'moderate' to 'warm' (see Table IV). The normal maximum temperature for the spring period is 45°, which is apportioned as follows over the 20 years: 715 days, or 39 per cent, had noon or mid-afternoon readings of 20° to 39°; 730 days, or 40 per cent, were between 40° and 59°; 257 days, or 14 per cent, were above 60° and 136 days, or 7 per cent, were below 20°. In the summer 50 per cent of the season averaged 'moderate' to 'warm,' accompanied by moderate to dry humidity, clear to partly cloudy skies and light to moderate wind; 15 per cent represented a similar type with a change to cloudy skies and humidity over 75 per cent. In

TABLE IV

SEASONAL FREQUENCY OF WEATHER TYPES, SAULT STE. MARIE, MICHIGAN

SPRING

Cloudiness	*Percentage*	*Wind*	*Percentage*	*Humidity*	*Percentage*	*Temperature*	*Percentage*
Clear	30.9	Light (0–9)	40.2	Dry (30–49%)	15.6	Very cold	7.3
Partly cloudy	26.3	Moderate (10–19)	45.0	Moderate (50–74%)	48.7	Cold	38.3
Cloudy	42.8	Strong (20 or over)	14.8	Humid (75–84%)	21.2	Cool	40.2
				Damp (85–100%)	13.7	Moderate to warm	13.7

SUMMER

Clear	36.2	Light	55.6	Dry	13.4	Cool	15.0
Partly cloudy	29.2	Moderate	37.4	Moderate	54.7	Moderate	57.3
Cloudy	34.6	Strong	7.0	Humid	18.0	Warm	24.0
				Damp	14.5	Hot	3.7

AUTUMN

Clear	17.0	Light	48.8	Dry	3.7	Very cold	1.2
Partly cloudy	21.7	Moderate	41.0	Moderate	39.4	Cold	26.0
Cloudy	61.3	Strong	10.2	Humid	29.6	Cool	46.1
				Damp	27.3	Moderate to warm	26.6

WINTER

Clear	15.4	Light	55.6	Dry	0.8	Frigid	6.5
Partly cloudy	21.6	Moderate	35.5	Moderate	22.1	Very cold	43.9
Cloudy	63.0	Strong	8.9	Humid	46.0	Cold	47.5
				Damp	31.1	Cool	2.1

the autumn there is a considerable increase in cloudiness and a fall of 25° in the normal maximum temperature between September and November. Thirty-two per cent of the season is 'cool' to 'cold' with cloudy skies and humid to damp air; 13 per cent is of the same temperature and humidity, but with clear or partly cloudy sky. Owing to the sharp demarcation between the earlier

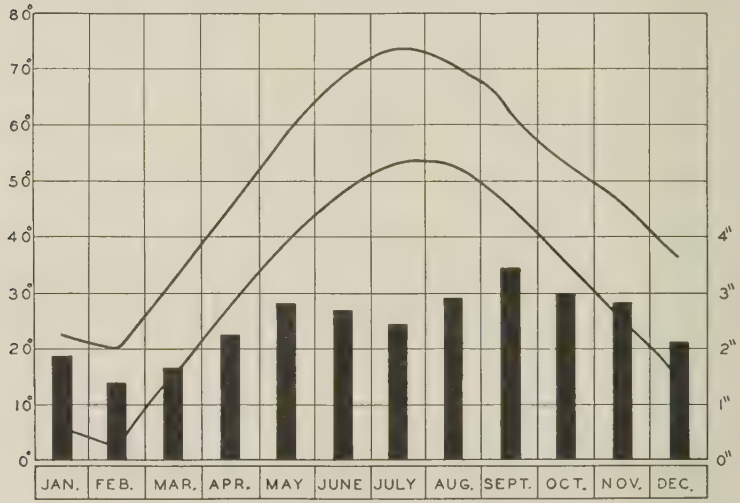


Fig. 11. Mean monthly maximum and minimum temperature and mean monthly rainfall, Sault Ste. Marie

and latter portion of the season, a general statement covering the fall months is difficult to make. In the winter period 31 per cent of all days are 'cool' to 'cold,' accompanied by light wind, cloudy sky and humidity over 75 per cent. Zero temperatures prevail 19 per cent of the time, with other conditions as stated, and 10 per cent represents subzero readings, dry air and light wind.

Rainfall frequencies have not been included in the present study. The occurrence of precipitation is largely dependent upon the passage of 'low' pressure areas which move across the country at frequent intervals. Sault Ste. Marie lies near the normal path

of most of the storm areas and receives a mean annual rainfall of about 30 inches, which is well apportioned through the year for the needs of agricultural interests (see Fig. 11). Upper Michigan's annual snowfall is near the maximum for the United States, a result of its proximity to Lake Superior and to the normal path of cyclonic areas, with their moisture-bearing winds.

San Juan, Porto Rico

JAVA: A STUDY OF POPULATION

SAMUEL VAN VALKENBURG

JAVA, with its dense population, intensive agricultural production and comparatively high cultural standards, is often presented in geographical literature as an exception to the rule that equatorial countries are not suited to high economic development. The explanation of the high Javanese development is, however, rather complicated and involves a number of factors. These coordinating factors make Java one of the most attractive countries for a detailed study of population with special emphasis on the future.

Java, an area equal to that of New York State, has at present a population of thirty-seven million and a population density of seven hundred per square mile. These striking figures have been reached only within the past few years, however. In 1800 the population was recorded as five million, showing that a sevenfold increase has been effected during the past one hundred and twenty-five years. Such an increase is not a unique phenomenon. There was a marked increase in population throughout the world's lands during the nineteenth century, Europe showing a growth of three hundred and forty-five million while Japan alone increased from thirty-two to sixty million since 1870. The uniqueness of the Javanese situation lies in the fact that Java is surrounded by regions in which the population is extremely sparse. Its astounding contrast is influenced partly by social factors, but as early as 1800, before the present social influences were at work, it was by far the most densely populated island of the Malay Archipelago, with slightly more than five million inhabitants.

A more comprehensive view of the population problem of the island is best gained by dividing the study into three major parts: concentration of population, present distribution and future overpopulation.

The different factors which explain this situation can be placed in two divisions: physical and social. Because the social factors are products of the physical environment only, it is profitable to discuss first the physical advantages of Java as compared with those of the neighboring islands.

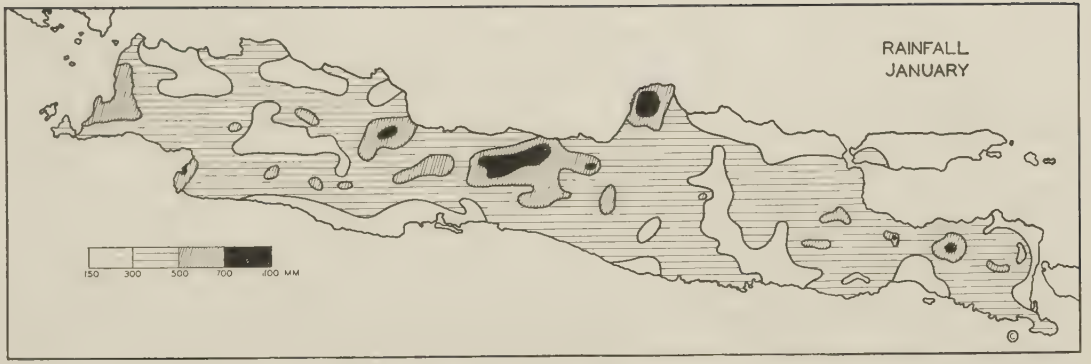
Relief plays an important part. From a tectonic point of view, the Malay Archipelago is divided into two sections, stable and unstable. The dividing zone runs along the eastern lowlands of Sumatra, parallel to the axis of that island, and bends toward the east just north of Java's north coast.

The stable, northern region is an old eroded area with large alluvial plains, surrounded by mountains. The Java Sea is of recent origin, probably owing to the rise of sea-level after the melting of the ice-age glaciers. On its bottom, continuations of the present river valleys can still be traced in the direction of the South China Sea. The Java Sea itself is very shallow and the coastal zone of the stable section, drowned during the formation of the sea, is being built up again by the vast amount of alluvium brought down by the rivers. These low alluvial plains of Sumatra and Borneo are swampy and unhealthy. Only on the natural levees along the rivers are settlements to be found and here fishing is the chief occupation. Only by careful drainage can these plains be made suitable for rice and estate types of agriculture.

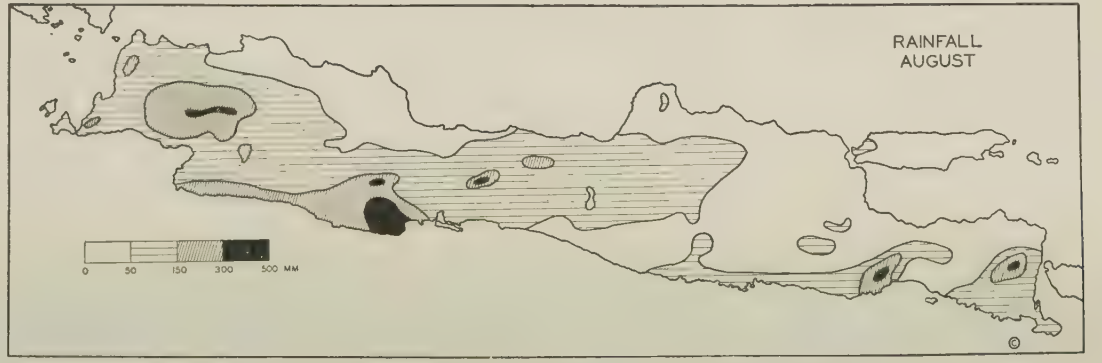
In the unstable region to the south and west conditions are quite different. Here is located the anticline of the Sunda fold, which shows recent tectonic movements which are not yet complete, as evidenced by the great number of earthquakes. It is a rough mountain area with steep coasts along which the various uplifted terraces, mostly of coral limestone, prove that the mountain-building process is still operative. The ruggedness of the topography makes it evident that there is little land available for agriculture. The river valleys are young and the slopes are often too steep for land utilization. Also, the anticline is often the cause of volcanic action, and, like the South American Andes, rows of volcanoes crown the ridges, especially in Sumatra and the east Sunda Islands.

What part does Java play in this system of stable and unstable lands? Java is a combination of both systems, having the good qualities without regard to the disadvantages. The northern section (Pl. LIII) belongs to the stable zone and the south lies in the region of unstable lands. In the north a vast alluvial plain extends into the shallow sea, but the influence of the adjoining unstable region is evidenced by the slightly uplifted coastal plain. This uplift facilitates better living conditions and better agricultural opportunities. The remaining portion of the island belongs to the unstable zone. There is a difference between the rather steep, uplifted southern part, where the rugged topography makes good transportation impossible and agriculture difficult, and the region of inland anticlines which are lower and often accompanied by rows of active volcanoes. These volcanoes (Pl. LIV) are not found on the mountain tops, but are separated by low gaps and are surrounded by fertile volcanic plains. Only in the western part are these volcanoes connected by higher uplifted areas, and even here the passages for transportation are easy. In addition to the fact that these volcanic uplands are of great fertility we must remember that they are of great importance in the regulating of rainfall. Without them eastern Java would have a far more pronounced dry season and a far less pronounced wet period. Hence these volcanic mountains have always been considered a blessing to Java. They do not act as barriers, but connect the low anticlines (islands in former time) and have made Java an island of great fertility, with a plentiful well-regulated rainfall.

Climate is also of great importance. Although Java is near the equator it has a monsoon type of climate with two distinct periods (Map 31); a rainy season from November to May and a dry period from June to November (Map 32). The rainy season is brought by western winds blowing from the Indian Ocean toward Australia, where the intense heat creates a low-pressure area. In western Java the rainy season is long and its intensity grows weaker toward the east because of relief influences, but even there the rainfall is plentiful and certain. In the dry season continental winds blowing from the east are only slightly affected by crossing over the inland seas between Australia and Java. When forced to



MAP 31. Showing amount of rainfall in Java during January



MAP 32. Showing amount of rainfall in Java during August

rise over the mountain sections of eastern and southern Java they cause rainfall, but the greater part of east Java is hot and dry. Toward the west the influence of the eastern winds is not so strong, and in the wind shadow of the central and western mountains local equatorial rainfall supplies in the dry season the water necessary for irrigating the adjoining lowlands.

There are two differences between the climate of Java and that of the surrounding islands. In the first place, the islands east of Java have a shorter rainy season and a more clearly marked dry period. Near Torres Strait northern Australia is extremely barren, in spite of the plentiful summer rains, because the dry period is too pronounced and long for the growth of a dense equatorial vegetation. Secondly, Sumatra and Borneo, lying across the equator, miss these seasonal rainfall divisions and have rain during the entire year. Continual rainfall is extremely detrimental to the soil. A dry season prevents incessant washing and leaching of the soil, thus insuring a good physical condition for the growth of crops.

It is obvious not only that Java has the advantages of relief, but also that it has profited by its location between the two climatic zones of the Malay Archipelago. In this respect, also, it has combined the advantages of both zones and is not troubled by the disadvantages of either one.

There are two dominating social factors, peace and prosperity, which make possible the present concentration of population. In all countries of the world we see periods of peace and prosperity marked by sharp increases in population and followed by periods of unrest and general decline. It is difficult to get figures about the population of Java before the nineteenth century; in fact, the accuracy of the present figures is questionable, but there seem to have been earlier periods of peace and progress in Java, especially during the time of the Indian cultural influence (Pl. LV). As early as the eighth century after Christ, the intermountain plains were well populated and many wonderful relics of temples show the high cultural standard of that time. This era of progress extended, in a minor degree, until the time of European influence, and Java was known throughout the world as a wealthy country

with important trade connections. It is extremely doubtful, however, whether the population ever exceeded five million. It was concentrated in the lowlands of central and eastern Java and the other sections were for the most part uninhabited. The coming of the Europeans, first the Portuguese and later the Dutch, did not mark a new period of progress, but rather one of decline. The Dutch East Indian Trading Company was not interested in the welfare of the island inhabitants. It wanted only profits for the shareholders and for two hundred years Java was exploited. The Dutch, however, occupied only a few of the coastal sections around the main harbors. Most of the interior was still independent, with local states where unstable conditions caused a sharp decline in prosperity.

In the nineteenth century there came a change. When the Dutch East Indian Trading Company was taken over by the Dutch Government, and especially after the British interregnum, a generally improved colonial system gradually extended over the whole island. This change of government marks the beginning of the great increase in population which was caused by the *Pax Neerlandica*. Java no longer suffers from exploitation, but is enjoying an era of progress. It has been made one of the most interesting tropical islands, a region of comparatively high tropical prosperity. As a result of these advantages in government and prosperity a new danger is approaching — overpopulation. Before this peril can be discussed, however, we must get a better understanding of the present distribution of the population.

PRESENT DISTRIBUTION OF POPULATION

In Java, as in every country depending almost entirely upon agriculture, there is a close relation between the density of population and the productivity of the soil. Because in tropical countries rice yields the highest average food value per acre, it is the most intensively cultivated crop (Map 33). In Java it occupies more than 40 per cent of the cultivated land. In all parts of the island except western Java, which has been only recently colonized, and, like Siam, Borneo and Indo China, is still in a period of rice export (Map 34), there is a distinct relation between the rice crop

PADDY PRODUCTION
EACH DOT REPRESENTS 50000 PICOLS
1 PICOL = 61.76 KG.
JAVA
KILOMETERS
0 100 200 300
MILES
0 100 200
B

MAP 33

AREAS OF LOWER PRODUCTIVITY
- REGIONS ABOVE 1,000 METERS
- TERTIARY SOILS
JAVA
KILOMETERS
0 100 200 300
0 100 200
MILES
B

MAP 34

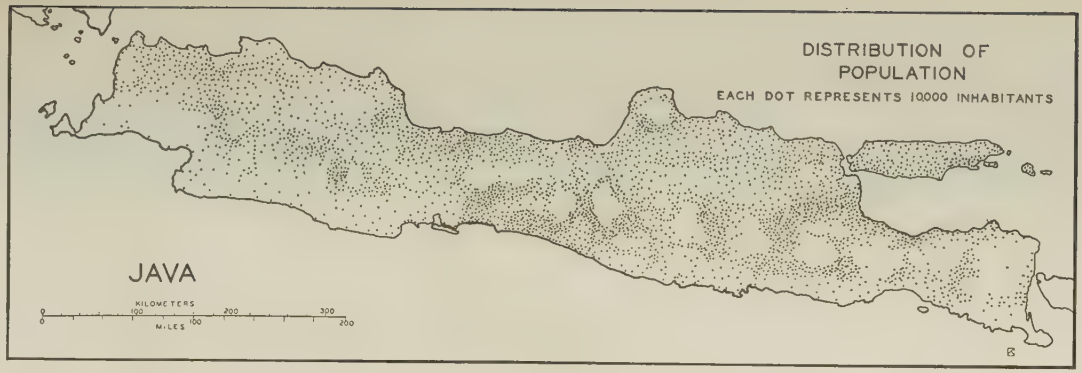
and the density of population. This relation is noticeable inasmuch as towns are unimportant and the larger ones are recent settlements due to modern trade conditions.

Realizing the close relation between density of population and soil, let us consider the population of Java on a basis of the physiographic regions. The lowlands adjoining the Java Sea and along the south coast of central Java have alluvial soil which makes possible a very dense population (Map 35), that lives for the most part on rice. The only exception is the coastal plain of western Java, which is partly of older geologic formation and of lower fertility (laterite) and is under a retarding influence because of large land holdings.

The interior mountain basins, filled with young volcanic, alluvial soil, produce rice and have a rather dense population. Some of them are comparatively high, especially in western Java, but most are lowland basins gradually emerging into the coastal zones just mentioned.

Because of their fertility the volcanic mountains are often cultivated high up on the slopes (Pl. LVI). Terraced rice fields rise up to 4,000 feet and fields of crops more suited to cool climates are found even higher (Pl. LVII).

Tertiary mountains and hills form a large area extending especially along the south coast, but covering also east-west zones throughout the northern part of the island. They form the entire island of Madura. This area cannot be considered as a whole because it contains soils of different value. The tertiary limestones are the least important and support only a comparatively low density of population. Their economic value lies, however, in the teak forests, which cover vast areas of the northern zone. The tertiary loamy regions are often of great agricultural importance; corn, cassava and rice are the main products. This is true of the tertiary conglomerates, partly of volcanic origin. In addition to the soil conditions there are a few other factors affecting the density of population in these regions. In western Java the southern tertiary belt was uplifted in young geologic times from three to five thousand feet. As a result of that uplift the relief in that section is still very young; deep valleys and steep slopes make


DISTRIBUTION OF
POPULATION
EACH DOT REPRESENTS 10000 INHABITANTS
JAVA
KILOMETERS
MILES

MAP 35

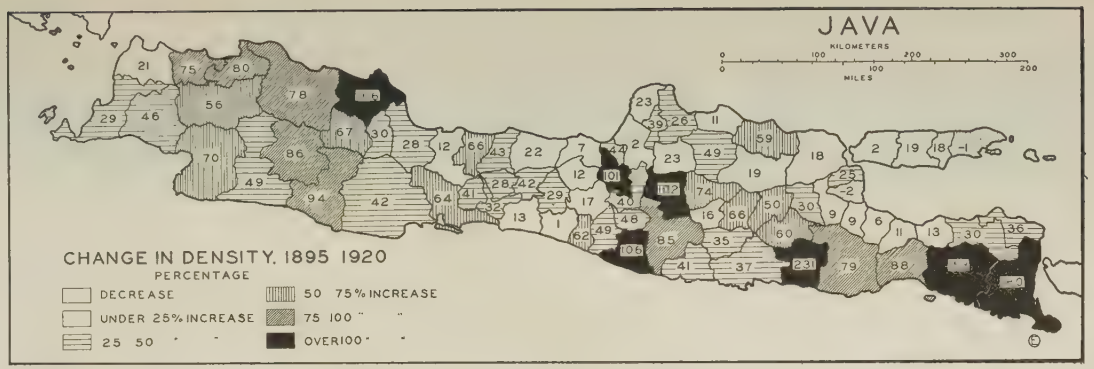
JAVA
KILOMETERS
MILES
DENSITY OF POPULATION
INHABITANTS PER □KM.
UNDER 100
100 200
200 400
400 600
OVER 600

MAP 36

cultivation difficult and transportation troubles are frequent. It is in these remote parts of Java that agricultural conditions are extremely primitive and the density of population is low. Other parts of the southern area of lower elevation, especially in the east, belong to the driest region of Java, not being affected by the rainfall around the volcanic mountains. It is in these zones that rice entirely loses its importance and is replaced by other crops (Map 36).

The maps of density and increase of population in the last twenty-five years show in an interesting way what the maximum density of population on different soils may be (Map 37). They indicate that increase, at present, is in regions which are sparsely occupied and where special projects of drainage and irrigation have caused better economic living conditions. For our purpose, however, the regions in which the density has not changed are of greater importance. We learn from a study of the maps that the rice-producing lowlands of high fertility, south of the harbor of Surabaja, for example, have reached a maximum density of sixteen hundred per square mile. This is also noticeable in the corn-producing regions of Madura, where the density remains about seven hundred and fifty per square mile. The surplus population of both regions migrates toward the south, where living conditions are better. By using these maximum density and soil calculations for all of Java, it is possible to make a rough estimate of the maximum population of the island. This can be done, however, only if we assume that living conditions and soil productivity will not change. The estimate shows that about 50,000,000 inhabitants can be supported on the island. An increase above that number would cause an overpopulation problem.

Density of population depends on the productivity of the soil and upon the standard of living of the natives. It is difficult to give in a few words a clear idea of the living conditions of the native Javanese. Some American authors have been rather sharp in their opinions. Edward Alsworth Ross says that "conditions are worse than hell. . . ." That is not true. Of course one cannot compare the Javanese standard with that of Iowa, as Ellsworth Huntington does in his book, *West of the Pacific*, but from a tropical


JAVA
KILOMETERS
0 100 200 300
0 100 200
MILES
CHANGE IN DENSITY, 1895 1920
PERCENTAGE
DECREASE
UNDER 25% INCREASE
25 50 " "
50 75% INCREASE
75 100 " "
OVER 100 " "

Map 37

FOOD SUPPLY I
REGIONS WHERE RICE WAS NOT THE MAIN FOOD IN 1896
PART OF THE RICE IMPORTED
JAVA
KILOMETERS
0 100 200 300
0 100 200
MILES

Map 38

point of view conditions are not bad. The yearly income per person is about twenty dollars, that is, one hundred dollars for a family of five. This appears to be a very small sum, but prices of food are low and the average quantity of food per person is 500 pounds of rice. This figure is higher than that of most other tropical countries. Houses in the tropics are only shelters in case of rain, and the diet of the natives is modest. Fruits grow everywhere and together with rice, a little fish, vegetables and spices form the staff of life. Famines do not occur in Java, partly because of measures taken by the government and partly because of the good means of transportation. Living conditions on the island are not ideal, but the standard of living has been raised in spite of the increase in population. Only a constant increase and attendant overpopulation can destroy the present advanced conditions.

The extraordinary increase in population from five million to thirty-seven million (1800–1925) gives the impression that our problematic total of fifty million will perhaps soon be reached, possibly within twenty-five years. Although indications during the past few years point to a slowing down of the ratio of increase, there is every reason for the government to study the possibilities of protecting Java from the wretched state of overpopulation. In this island it is impossible to know in detail the increase in population each year. The death-rate has been fixed at 22 per thousand and is remaining constant. It is a low rate for tropical countries and may be expected to decrease, thanks to modern hygienic methods now being used. A death is well known and is usually accompanied by an obsequial ceremony, but birth seems to be of less importance and often escapes official attention, with the result that the birth-rate is still a mystery.

FUTURE OVERPOPULATION

There are two methods available in dealing with overpopulation problems. One merely postpones the period of overpopulation and and the other tends to prevent the condition.

It is possible to delay the period of overpopulation by increasing the area of land for native agriculture. During the last century the area of tilled land has increased considerably. By means of

irrigation (Pl. LVIII) it was possible to increase the rice-field area a great deal. The planting of crops that do not need irrigation has also increased until today corn, cassava, sweet potatoes and mountain rice occupy 60 per cent of the cultivated lands, leaving only 40 per cent for rice. From 1916 to 1925 the increase of cultivated land was $1\frac{1}{2}$ per cent a year, even slightly higher than the increase in population. Of course, in spite of all efforts of the government to open the still sparsely occupied regions and bring them under cultivation, the increase cannot go on forever, for only 24 per cent of the island is at present left unproductive. This 24 per cent includes space for roads, houses and high mountains, as well as some soil of very low productivity. At present, the native agriculture occupies 54 per cent of the total area; estate agriculture 5 per cent and forests 17 per cent, of which 6 per cent is teak. Most of the land belongs to the natives, but about 11 per cent of the country is occupied by private land and European estates. The area of private land is decreasing rapidly because the government is buying the holdings and returning them to the natives. It seems almost an injustice that an island as densely populated as Java should have 4 or 5 per cent of the land taken up with European estates engaged in the production of rubber, sugar, coffee, tobacco and quinine. Because of their remote locations, however, parts of this estate area would be of no value for native crops. The sugar and tobacco area ($1\frac{1}{2}$ per cent) is well suited for native crops, however, located as it is on the irrigated lowland plains. There are two reasons why this land should not be used for native crops.

The natives loan their land for these estate crops and the leases are for one crop only. Working in the sugar factory or as field laborers they receive four times as much profit from their acres as they would if the land were used to produce a crop of rice. Also, the taxes on the profits made by these European estates form the most important part of the government revenues. Without the tax quite a number of useful institutions of great value to the natives would be impossible because the tax capacity of the native is still too small to make a modern budget possible. Nevertheless, in 1918, during the time of economic difficulties, the government

seriously considered diverting 25 per cent of the sugar-producing area to rice, thus making Java self-supporting. Now, $2\frac{1}{2}$ per cent of the food is imported. After-war conditions prevented this idea from being carried out.

A greater food yield per acre would make possible the support of a larger population. On comparing the average yield per acre of Java with that of other countries it still seems possible to increase the production a great deal. The rice yield per acre in Japan is twice as high as that of Java and the same statement can be made for nearly all her native products. But the Javanese is conservative; he does not like to change from the methods of his grandfather. The influence of the modern colonial system is only slightly felt as compared with that of former oriental conditions. Only persuasion, not force, can be used. The change is small, but a great deal is done in this direction by government agricultural experts, partly by showing better methods of cultivation and partly by providing seeds of selected quality.

By changing the diet from rice to a food crop more suited to the dry season (Map 38), and with a greater food value, more land could be utilized more intensely for the production of food. The great change in diet during the past years (Map 39) is shown clearly by the maps. By converting the food value of the different crops into rice value, there are 500 pounds per year for every Javanese (Map 40). Of these 500 pounds, only 180 pounds are consumed as real rice, and $2\frac{1}{2}$ per cent is imported as rice from Burma, Siam and Indo-China. The maps show that in western Java, with its less pronounced dry season, rice is still the predominating food.

The introduction of manufacturing industries would attract the population to the cities and towns and leave more land free for crop production. In the last twenty-five years the matter of introducing these industries into Java has been advocated several times and different projects have been presented to the government. But, in a young tropical country like Java, one cannot expect to establish and maintain an industry great enough to attract people to the towns. There are no natural resources such as coal and iron in Java and the water and hydro-electric power is limited. Some manufacturing industries based on home produc-

FOOD SUPPLY II
REGIONS WHERE RICE WAS NOT THE MAIN FOOD AFTER THE BIG RICE CROP OF 1924
PART OF THE RICE IMPORTED
JAVA
KILOMETERS
0 100 200 300
0 100 200
MILES

MAP 39

FOOD SUPPLY III
REGIONS WHERE RICE WAS NOT THE MAIN FOOD BEFORE THE BIG RICE CROP OF 1924
PART OF THE RICE IMPORTED
JAVA
KILOMETERS
0 100 200 300
0 100 200
MILES

MAP 40

tion, such as the tobacco factories and the rice-straw factories, have flourished, but a change from a system of free trade to one of protective tariff would be necessary before other industries could be made possible. High prices, which the home market cannot stand, would be the result of blocking the industrial import. Any big manufacturing industry, therefore, would not be natural and would be a burden rather than an aid to the natives.

An overcrowded island, surrounded by others where an increase is not only possible but desirable, appears to be a logical source for migration. In reality, this process is not easy. Compared with Java, the islands of Sumatra and Borneo, the most natural objectives for emigrants, are still very uncivilized and hence do not attract Javanese. Even with government aid in clearing the equatorial forest lands and in draining the lowlands, colonization from Java to these islands has been negligible. Some Javanese work in Sumatra, on contract, but they return as soon as their contract permits. It is unfortunate that people living under equatorial climatic conditions seem to lack the necessary energy to go away to other lands and start life anew. Those who do leave are usually outcasts of their environment and the governmental offer to migrate is the only hope they have. They leave, not of their own will, but because they are forced to go. Even when capital is supplied by the government, the migrating Javanese lacks the energy to carry him through the first trying years and he becomes homesick for his native island. He either dies a homesick man or is brought back to Java. As long as the Javanese is not forced to leave the country, he will stay where he is, where his father and grandfather were and where he feels at home. He does not look into the future as do the peoples of the temperate zones.

With a dropping death-rate, birth-control is perhaps the only solution left to prevent overpopulation. The subject of birth-control falls outside the field of geography and the discussion of its value should be left to other branches of science. It can only be said that birth restriction is not generally known in Java because of the absolute obstruction of the Mohammedan church and the government's wish to avoid as long as possible any disagreement with that great force. It seems probable, however, that the

(Photograph by Royal Air Force)

Delta on the northern plain (Tjimanuk)

(Photograph by Royal Air Force)

Crater in eastern Java (Klut)

(Photograph by Royal Air Force)

Barábudur, restored Hindu temple in central Java

(Photograph by Royal Air Force)

Volcanic mountains in eastern Java (Ardjoenå) with cultivated slopes and intermountain plains

(Photograph by Royal Air Force)

Terraced agricultural lands between Bandung and Garut in western Java; seen from above

(Photograph by Royal Air Force)

Forested mountain (with sulphur lake) and irrigated intermountain plain in western Java

birth-rate will drop of its own accord. The effort to maintain the present relatively high standard of living may effect it, unconsciously. Even in Java the influences of modern civilization, motor cars and movies, have penetrated the remotest corners and have taught the natives the value of a little spare money aside from that needed for food and shelter.

To present a picture of one of the greatest population problems as it relates to a small island like Java has been the purpose of this study. The outlook for Java is not a very pleasant one, but we have shown here that there are still a number of means for postponing or preventing the overpopulation of the island and later other methods may develop from an ever changing world condition.

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NATURAL GEOGRAPHIC DIVISIONS OF LAND

JETHRO OTTO VEATCH

THE word "land," like most words which have been in universal use for a long period of time, has acquired a multitude of meanings. Taken from its context it does not mean anything definite. It may be given a most comprehensive and all-inclusive meaning, as in the ponderous definition given by Blackstone,[1] or may have a more restricted and specialized meaning according to its use by the agriculturist, the economist, the geographer and the geologist.

In its broadest scientific meaning it comprises the solid part of the earth (the lithosphere), in contradistinction to the hydrosphere and to the atmosphere. To be a little more specific, it comprises the surface part of the lithosphere. But since it was observed that the physiognomy of the land was not everywhere the same, it became necessary to distinguish the different aspects; therefore, such broad divisions as mountains, plains and plateaus were made; and with the division carried still farther, secondary and minor features of a topographic nature, such as hills, valleys, lakes, scarps, mesas and similar features, were recognized.

Again, it was found that certain areas could be isolated which possessed a common geologic history and the same general surface aspect — physiographic divisions. This in brief constitutes a basic scientific conception of land, but it is properly a classification of land forms and is purely geologic or physiographic in nature.

Then man enters, and subdivisions of the earth's surface are made purely in relation to his material needs. Such classifications

[1] "Land comprehends all things of a permanent and substantial nature; being a word of very extensive signification." — *Commentaries*, Book II, Chap. 16.

have not been scientific in a stricter sense of the word, and are not natural, but generally have been purely utilitarian, artificial or local in their application.

However, it may be possible to construct a plan for the classification of land which would include the environmental factors of soil and vegetation as well as topography, and which would still be a part of a natural classification. The divisions of this classification could be considered properly geographic. The broadest divisions of land, according to this conception, are essentially climatic: arctic, temperate and tropic. Subdivisions of the next order or rank would be based upon peculiar combinations of the criteria of the geographic classification: homogeneity in soil, vegetation and drainage. Such subdivisions would be nearly equivalent in their boundaries to the major soil families of the world. The boundaries of these divisions might transcend those of the major physiographic divisions; or, on the other hand, a single physiographic division might include two or more major geographic land divisions. For example, in the eastern part of the United States the major land divisions have a rough zonal arrangement north and south, while the major physiographic divisions have a general east-west parallel arrangement. For an additional illustration, the Great Plains may include two or more major geographic land divisions.

The next lower rank comprises subdivisions based upon a narrower range in altitude, soil and vegetation. The delineation of these geographic areas may be accomplished in this manner: on the basis of accumulated facts from detailed surveys of the topography, vegetation and soil, by trial and error, a single area may be finally isolated which is different in aspect from any other area in the same general region. The geographic divisions so outlined can perhaps be best designated by compound names, a place name and terms signifying some outstanding character in soil, vegetation, topography and geology, for example, Chippewa Clay Plains, Grayling Pine Plains, Yazoo Bottom Lands and Miami Limestone Region.

Smaller geographic units may be recognized on the basis of differences in degree, that is, the range permitted in slope, drainage

and vegetation is still more restricted than in the preceding divisions. These smaller units might be the equivalent in distribution to soil types (the unit of the detailed soil map); or, they might represent associations of soil types. A uniform clay soil dotted with small bodies of sand, or a network of dry sandy soil and small bodies of muck and water surface, would constitute peculiar types of land of local significance.

So far as the writer is aware, there have been but few conscious attempts to map natural land divisions.[2] Probably most land maps are purely use maps. These are open to the criticism that they tell nothing directly about the intrinsic nature of the land — the chemical and physical nature, and durability of the soil and the nature of the topography and the vegetation. In addition, these maps may have no more than a temporary value since use of the land is quite likely to change with political and economic conditions.

Land divisions have been made on a climatic basis also and such comprehensive classes as "arid land" and "humid land" are natural divisions. However, in areas of small extent, especially where a single element of climate, as precipitation or temperature, is employed as the basis of classification, inferences concerning the character of the land may be greatly in error.

Physiographic and geologic maps are perhaps most frequently substituted for land maps. It may happen that the physiographic unit as drawn by the physiographer is also a land unit, but also it may be that the physiographic division has such a wide range in climate, soil and vegetation that it possesses no homogeneity as land. A physiographic division may be a function of geologic agencies and may be inherited from a past geologic period. The land (in the geographic meaning) is a function of present climate, soil and vegetation.

[2] In this connection, however, the county maps made by the Michigan Land Economic Survey constitute an exception. The work of R. M. Harper in subdividing Florida and Alabama into geographic regions should also be mentioned. A much stronger emphasis is placed by him upon vegetation and geology than on soil in determining the separate divisions. (See *Florida Geological Survey, Sixth Ann. Rep., 1914; Eighteenth Ann. Rep., 1927;* and *Alabama Geological Survey, Monograph 8, 1913.*)

Descriptions of land on a vegetational basis, such as "grass lands," "pine lands," "prairie," "savannah," are generally inadequate, since other elements of land, as surface configuration and soil, cannot always be inferred with assurance of correctness.

It follows that some kind of classification of land on a natural basis would serve a useful purpose in facilitating and clarifying geographic description. It would also constitute basic knowledge for the economic classification.

The ideas on land classification presented in this paper are embraced in the accompanying map and schematic table. The classification in its present form is perhaps no more than a suggestion for the need of one and is not offered with any pretensions to scientific completeness.

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Outline Scheme of Land Classification

Lithosphere

- Land forms (Geologic and physiographic)
  - Continents
    - Plains — Physiographic divisions: Piedmont plateau; Atlantic coastal plain; Great basin; Etc.
    - Plateaus — Topographic forms: Hills; Valleys; Lakes; Scarps; Etc.
    - Mountains
- Natural land divisions Geographic
  - Land Regions
    - Arctic
      - Ice
      - Tundra
    - Temperate
      - Pedalferic
      - Pedocalic
    - Tropic
      - Pedalferic
      - Pedocalic
  - Major divisions — Land types: Steppe black lands; Gray lands, north forest; Brown earth lands; Desert lands; Etc.
    - Criteria
      - Soil
      - Topography
      - Vegetation
    - Example
      - Coastal flatwoods
      - Grayling pine plains
      - Chippewa clay plains
    - Minor unit — Equivalent to soil type
- Use divisions (Economic or commercial)
  - Agriculture
    - Farming — Types and kinds according to crops — Classes according to value
    - Grazing — Grass; Brush; Swamps — Classes according to value
  - Forestry — Types according to species, pine lands, oak-hickory, etc. — Classes according to timber value; Productivity of soil
  - Mining — According to mineral and kind of mining — Classes according to value
  - Urban — Residential; Business; Etc. — Classes according to value

MAP 41. Natural land divisions of Michigan

LEGEND FOR MAP OF LAND DIVISIONS OF MICHIGAN

Name	No. on map	Soil	Topography	Vegetation
Monroe lowland clay plains	1	Dark-colored fertile loams underlain by clay	Flat, level, in large part poorly drained; low, narrow sand and gravel ridges	Hardwood forest; elm, soft maple, ash, hickory and swamp white oak; locally tulip, cottonwood, walnut, chestnut
Washtenaw high clay land	2	Loam soils underlain by clay; medium to high fertility	Rolling plains	Hardwood forest; beech, maple and oak, hickory
Hillsdale-Lapeer sandy highland	3	Light-colored sandy loams and sands; medium to low fertility; in part stony; large aggregate of muck	Rolling and hilly highland with included level and pitted dry sand plains; lakes and swamps characteristic	Hardwood forest; mainly oak, hickory; scattered white pine in northern part
Branch plains	4	Complex of dark- and light-colored loams; medium to high fertility; dry sandy loams	Undulating plains of clay land, and level dry sand plains; lakes and swamp	Hardwood forest; beech, maple, oak, hickory
Kalamazoo sandy plains	5	Sandy loams and sands; medium to low fertility; large aggregate of muck	Level plains, in part pitted with lakes; and locally choppy with steep slopes	Hardwood forest; mainly oaks, hickory, partly prairie and oak openings
Cass sandy hill land	6	Sandy loams and sands; medium fertility	Hilly, ridges inclosing dry sandy valleys; slopes generally smooth, but locally knob and basin topography	Hardwood forest; oaks, hickory
Paw Paw sandy plains	7	Sandy loams and sands; medium to low fertility	Level plains, including a large aggregate of swamps and lakes	Hardwood forest; oaks, hickory; oak openings and patches of prairie
Allegan clay upland	8	Loams underlain by clay; medium to high fertility; sandy loams underlain by coarse, sandy drift	Undulating to rolling clay plains; rolling to hilly sandy ridges; slopes generally moderate	Hardwood forest; beech, maple, oaks, hickory

LEGEND FOR MAP OF LAND DIVISIONS FOR MICHIGAN (*continued*)

Name	No. on map	Soil	Topography	Vegetation
Lake Michigan lowland plain..	9	Complex of wet and dry sands; loams underlain by heavy clay; sands of low fertility; clays medium to high fertility	Smooth land, low ridges and gentle swells; large aggregate of wet land; dunes along the lake shore	Forest; oaks on the drier sands; elm, soft maple, aspen, ash, oaks on the wetter sands; beech, maple, elm, basswood, hickory on the clays; pine abundant in the more northern areas
Clinton rolling plains.....	10	Loams over compact clays; medium to high fertility; not excessively stony; large percentage muck	Level to rolling clay plains with hilly and rolling ridges at broad intervals; swamps generally in long, shallow valleys	Hardwood forest; sugar maple, beech, oaks, hickory
Mecosta-Wexford sandy highland.....	11	Mainly deep sandy loams; locally sandy loams and loams underlain by red clay; mostly medium and low fertility	Rolling and hilly, locally slopes excessively steep; lakes and swamps comprise large aggregate acreage	Hardwood forest; sugar maple-beech; mixed hardwoods, hemlock, and white pine; swamps of cedar, tamarack, fir and spruce
Saginaw lowland plains.....	12	Complex of wet and dry sands and dark-colored clay and loams; heavy soils, high fertility; sands of low fertility	Level land; low swells and low narrow sand ridges; large proportion poorly drained	Forest; elm, ash, maple, basswood; white pine on sands and wet land
Sanilac rolling clay plains.....	13	Light- and dark-colored loams over clay; locally stony	Level plains and gently rolling upland; less swamp, more rolling than 1 and 12	Forest; elm, ash, soft maple, basswood, beech, maple, white pine
Newaygo-Manistee sandy plains	14	Mainly sands and light sandy loams; dry, and low fertility	Level dry sand plains; also hills and ridges with smooth slopes	Forest; white, Norway and jack pine; oaks
Oceana hill land.....	15	Mainly sandy loams; locally loams and sandy loams underlain by red clay; medium fertility	Hills with moderate slopes; level plains underlain by clay and cut by streams; dunes along the lake shore	Forest; mainly hardwoods, maple, beech, hemlock; locally white pine mixed with hardwoods; jack and Norway pine on drier sands

Name	No. on map	Soil	Topography	Vegetation
Missaukee clay plains.....	16	Mainly sandy loams and dark-colored loams over impervious reddish clay; medium to high fertility	Flat or wet and swampy with low swells	Forest mixed hardwoods, maple, beech, elm, basswood, white pine, hemlock, fir, cedar and spruce
Grayling pine plains.....	17	Sands, dry, acid, low fertility and productiveness; large aggregate acreage of peat soil included	Level and pitted dry plains; smaller areas of sandy hill land; swamps and lakes included	Forest; Norway and jack pines; smaller growth blueberry, sweet fern, grasses, lichen; oaks and aspen second growth
Ogemaw pine hills.....	18	Sands, dry, acid, low fertility; smaller aggregate of light sandy loams and sands underlain by sandy and impervious clays	High broadly rolling hills and plateau-like upland forming a drainage divide	Forest; Norway pine characteristic; in part white pine and mixed hardwoods, pine and hemlock
Gladwin clay upland.....	19	Sandy loams and light loams over red clay; medium fertility and productiveness	Moderately rolling and nearly level; small aggregate of wet land	Forest; mainly hardwoods, maple, beech, birch, basswood; local areas of mixed white pine; fir and spruce on wet land
Iosco sand plains.....	20	Mainly dry, acid sands of low fertility; small aggregate of wet infertile sands, and moderately productive sand over clay	Nearly level; low sand ridges on the lake shore	Forest; mainly Norway, jack and white pines
Montmorency hill land.....	21	Sandy loams underlain by sandy clay; moderate fertility; dry acid sands of low fertility included	Broadly rolling hills and both wet and dry sandy valleys and plains; high plateau-like upland	Forest; part pine and part hardwood hills, Norway, white and jack pines on the dry valleys and plains

LEGEND FOR MAP OF LAND DIVISIONS OF MICHIGAN (*continued*)

Name	No. on map	Soil	Topography	Vegetation
Alpena stony clay land.....	22	Loams and sandy loams underlain by reddish limy clay or by limestone bed rock; stony but fertile soils; much peat; also dry sands, gravelly and cobbly soils	Nearly level or gently rolling clay plains including swamps and lakes; low sand and gravel ridges and stony knobs; level plains underlain by limestone bed rock	Forest; hardwoods and mixed fir and spruce on the clay lands; cedar, fir and spruce, white and Norway pine on wet stony land, and dry sands and gravel
Cheboygan lake region.....	23	Complex of infertile dry and wet sands, peats and stony gravelly soils; with some productive red clay and stony limy sandy loams	Level lake bed plains of both clay and sand; low dunes or beach ridges; isolated hills, lakes and swamps	Forest; complex of hardwoods on the hills; hardwoods, fir and white pine and spruce on the clay and wet mineral soils, cedar, fir, spruce in the swamps
Emmet sandy upland.....	24	Dry sands and sandy loams underlain by moderately limy gravel or by sandy clay; medium fertility	Smooth upland-level valleys and plains; in smaller part, hills with excessively steep slopes	Forest; mainly hardwoods, maple, beech, birch and hemlock
Muskegon sand plains.....	25	Sands, acid and of low fertility; mostly deep, but locally underlain by clay at shallow depths	Smooth plains, locally interspersed with dry depressions and by lakes	Forest; mainly white pine, but in part mixed pines and hardwoods
Antrim hardwood highland....	26	Sandy loams and sands underlain by moderately limy sandy loams, clay or sand; moderate fertility; much peat	Hilly, and locally broken with steep slopes, but with even sky-line; bold westward front with deep valleys, which are in large part occupied by peat swamps	Forest; mainly hardwood, maple, beech, birch, hemlock
Traverse clay land.....	27	Loams and sandy loams underlain by pale reddish limy friable clays; fertile, productive soil, in part stony	Rolling plains, parallel ridges, the valleys occupied by lakes or swamps; large area of lake surface	Forest; hardwoods, beech, maple, birch, elm, ash, basswood
Leelanau hills.....	28	Sandy loams and loams underlain by limy clays and limestone gravel; moderate fertility; in part very stony	Hilly; in part bold steep slopes, in part broadly rolling; sandy plains and dunes included	Forest; mainly hardwoods

Name	No. on map	Soil	Topography	Vegetation
Benzie upland.....	29	Sandy loams and sands; locally small patches of loam underlain by heavy limy clay; soils of moderate fertility and productiveness	Higher land an even-topped plateau, broadly rolling, locally chopped and deeply dissected by stream valleys; dunes near lake shore; large aggregate of swamps and lakes	Forest; mainly beech, maple, birch, hemlock
Mancelona hardwood plains...	30	Brown sands and sandy loams underlain by dry gravel and sands; limestone and shale influence; locally excessively cobbly; soils moderately productive, but poor infertile sands included	Dry plains, cut by dry valleys bordered by low scarps; numerous dry depressions; lakes and swamps interspersed	Forest; mainly maple, beech, yellow birch, hemlock; locally white and Norway pines
Kalkaska hill land.....	31	Sands and sandy loams underlain by sandy clays and locally by heavy red clays; intermediate limestone influence; medium fertility and productiveness	Plateau-ridge; broadly undulating to rolling	Forest; sugar maple, beech, yellow birch, hemlock; locally white pine
Manistee valley plains.....	32	Sands and sandy loams underlain by dry sands and gravel; acid, low fertility; large aggregate of sands over red plastic clays at shallow depths	Mixed dry and wet sandy plains, with large percentage of swamp	Forest; white and Norway pines; swamp conifers and hardwoods on the wet land
Crawford plateau highland....	33	Loamy sand, sandy loam and loam underlain by sand and gravel; intermediate limestone influence	Nearly level or gently rolling high land, having bold slopes on the borders of the dry sandy valleys and plains	Forest; sugar maple, beech, birch, hemlock

LEGEND FOR MAP OF LAND DIVISIONS FOR MICHIGAN (*continued*)

Name	No. on map	Soil	Topography	Vegetation
Isabella red clay lands.....	34	Sandy loams and loams underlain by red clay; relatively medium to high productivity; less extensive acreage of sandy loams and sands of medium to low productivity	Rolling clay plains, with ridges at broad intervals, which have rolling to hilly topography	Forest; sugar maple, beech, elm, basswood, on the clay lands; mixed white pine and hardwoods on the hills
Chippewa clay plains.....	35	Gray, blackish and reddish soils, underlain by reddish limy clay; no or relatively little stone; high fertility	Low-lying level plains, in part poorly drained	Original forest mixed hardwoods, white pine, hemlock, fir and spruce
Mackinac stony land.....	36	Loams underlain by clay, fertile but excessively stony; dry acid sands; limy gravelly soils; large aggregate of peat and muck	Level plains both dry and wet; gravelly ridges; plateau-like ridges and hills of limestone	Hardwoods on the higher land; mixed hardwoods, pine, spruce and fir on the wet land and dry sand and gravelly ridges
Gilchrist sandy plains.....	37	Brown loamy sands, in part stony, in part stone-free; dry yellow sands, stony loams and peat	Level or gently rolling sandy plains, stony hills and limestone plateaus	Beech, maple, birch, hemlock on the better sands and stony lands; pine on the drier sands
McMillan hardwood upland...	38	Brown loams and sandy loams underlain by clay and sand; stony in places; moderate to strong limestone influence; medium fertility	Level, gently rolling to moderately hilly	Mainly beech, maple, yellow birch and hemlock
Taquamenon swamp region....	39	Peats and mucks; small areas of silts, fine sands and clay; wet but fertile	Swamps; low-lying wet clay plains; low hills and ridges of sand	Mainly spruce and fir; in part mixed hardwoods and swamp conifers
Luce sandy hardwood uplands.	40	Brown, loamy sands and sandy loams, very strongly acid, little or no limestone influence; medium to low fertility	Level to rolling sandy plains and plateau-like ridges; small areas of hilly highland	Mainly beech, maple, birch and hemlock

Name	No. on map	Soil	Topography	Vegetation
Whitefish sandy pine lands....	41	Dry acid sands and peats low in fertility; small bodies of brown loamy sands, sandy loams, and wet clay land	Level plains, swamps, low sand ridges and dunes	Mainly Norway, jack and white pine; swamp conifers, small areas of hardwoods
White Rat pine plains.....	42	Dry acid sands, low fertility	Level and pitted dry sand plains	Mainly pine
Seney swamp region.....	43	Mainly acid peats; dry and wet sands, low fertility; small areas of iron hard-pan soils; small areas underlain by limestone bed rock, and coarse limy drift	Swamp containing flat islands and ridges of loose sand; swampy low-lying level plains; a few hills	Mainly black spruce, tamarack and cedar; Norway, jack and white pine on the sandy soils
Munising hardwood upland....	44	Loamy sands and sandy loams, medium fertility; locally stony; locally, slopes are excessively steep	Mainly rolling and moderately hilly; locally slopes excessively steep	Mainly hardwood forest; beech, maple, birch and hemlock
Wetmore sand plains.....	45	Dry sands, low in fertility	Level and pitted sand plains, a few lakes and considerable swamp included	Mainly pines; in part hardwoods and hemlocks
Manistique stony lowland.....	46	Brown loamy sands, stony and large blocks and bed rock of limestone; dry and wet sands of low fertility; small bodies of stony loams and sandy loams of high fertility	Level and rolling stony plains; large aggregate of swamp	Mainly hardwoods; pines on drier sands; conifers in swamps
Delta sandy lowland.....	47	Dry acid sands of low fertility; small spots of wet clay soil, moderate fertility; spots of stony limy soil	Dry sandy plains and swamps; low sandy ridges	Mainly pines; hardwoods on stony and clay lands

LEGEND FOR MAP OF LAND DIVISIONS FOR MICHIGAN (*continued*)

Name	No. on map	Soil	Topography	Vegetation
Steuben hills	48	Sands and sandy loams of low fertility; small limestone influence	Upland; hills, basins, dry valleys, plains; lakes numerous	Maple, beech, birch, hemlock; also in large part Norway and white pine and mixed pine-hardwoods
Trenary hardwood plains	49	Brown and reddish loams underlain by clayey subsoils; in large part stony and underlain by limestone bed rock; fertile soils; also stony sandy loams underlain by limy sands and clays	Rolling to level highland, includes low ridges and a large aggregate of swamp; hill land in the western part	Mainly maple, beech, birch forest; mixed hardwoods, white pine, spruce, fir on wet land
Menominee hardwood upland	50	Mainly loams and sandy loams underlain by clayey, limy subsoils; fertile productive soils	Oval ridges and hills alternating with swampy valleys; gravelly stony plains	Hardwood hills, maple, beech, birch, basswood, ash, elm; pine, fir, spruce, hardwoods on wet soils; spruce, fir, cedar in peat swamps
Escanaba sandy lowland	51	Dry sands and peats of low fertility; stony and gravelly moist loams of fair fertility	Sandy, swampy and wet stony plains; dry sandy plains, and low sandy ridges	Mainly cedar, spruce, fir, white pine, aspen, birch, on wet land; Norway pine on dry land
Onota stony highland	52	Reddish, sandy soils, excessively stony and in part underlain by sandstone bed rock at shallow depths	Plains and plateaus trenched by streams and bordered by bluffs along Lake Superior	Mixed forests, maple, birch, beech, hemlock, fir, cedar, and white pine
Swanzy sand plains	53	Dry sands, poorly productive; some stony soil included	Plains; level or slightly undulating	Mainly pines
Dickinson sandy hill region	54	Sandy loams on hills, showing influence of limestone; productive soil; dry sand hills; dry sand plains; thin stony, sandy loams and loams on bed rock	Hills; knob and basins; swells and sags; rock hills and plateaus with steep slopes; large aggregate of lakes and swamps	Hardwoods; maple, birch on sandy loams; conifers on thin soil of rock knobs; pines on dry sand hills and sandy valleys

Name	No. on map	Soil	Topography	Vegetation
Marquette stony highland....	55	Thin stony soils on bed rock; coarse deep, dry sandy soils in valleys; local patches of productive red loams	Mountains, hills and rock knobs with steep slopes; valleys with rough pitted uneven surfaces; lakes and swamps numerous	Hardwoods, maple, birch on the deeper, heavier soils; conifers in swamps; pines on the drier sands and the thin rock soils
Iron River stony loam highland	56	Reddish stony loams and silts; medium to high fertility; generally moist; generally stony throughout the whole thickness	Smooth plains; locally choppy and undulating; local stony hills and ridges; lakes, swamps and poorly drained mineral soils	Hardwoods, maple, birch, elm, basswood; fir and spruce local or intermixed with the hardwoods
Baraga stony highland.....	57	Grayish and yellowish stony silts, and loams; cold, acid soils; in part wet at shallow depths and resting on bed rock at three feet or less	High table-land, locally ledges and cliffs of rock; large aggregate of wet land; small aggregate of dry sandy plains	Hardwoods; maple, birch forest; mixed maple, birch, cedar, fir, hemlock, spruce and wnite pine
Watersmeet hardwood hills region.....	58	Mainly sandy loams, locally reddish loams; in part dry, in part moderately fertile; locally stony, but deep penetrable soils	Hilly plateau region; sags and swells; high plateau ridges and irregular dry valleys; lakes numerous; elevations: 1200 to 1700 feet; slopes locally very steep	Mainly hardwood forest; maple, birch dominant
Bessemer stony highland.....	59	Thin, stony soils, mostly loams and sandy loams; moderately productive; locally patches of red clayey soils, productive but stony	Ridges and parallel lines of hills or knobs; level stony plains in part; elevations 1300 to 1700 feet above sea-level	Mixed hardwoods and conifers
Gogebic stony plain.....	60	Soils wet and moist; thick forest mold or thin muck cover, over stones on bed rock or over stony, sandy clay; productive	Semi-wet and swampy; undulating and level plain; small aggregate of hills and ridges included	Coniferous; fir, cedar, spruce, hemlock, white pine; locally maple, birch, hardwood forest

LEGEND FOR MAP OF LAND DIVISIONS FOR MICHIGAN (*continued*)

Name	No. on map	Soil	Topography	Vegetation
Porcupine rock knob region...	61	Thin stony soils on bed rock; valleys have reddish loams and sandy soils; productive, but excessively stony	High rock knobs and ridges 1200 to 2000 feet above sea-level; rough uneven surface and steep slopes	Hardwoods on the deeper stony loams — maple, birch, elm, basswood; white pine, fir, spruce, cedar on the thinner and on the wetter soils
Ontonagon lake plains.....	62	Silts, clays and fine sands underlain by limy silt, clay and fine sand; locally dry and wet acid hard-pan sands	Level or gently sloping terraced plains, trenched by streams	Mixed hardwood-conifer forest; maple, birch, basswood, white pine, fir, cedar and spruce
Ontonagon high clay plains...	63	Silts, clays and blackish wet loams underlain by red, impervious limy clay; productive, durable soils	Nearly level plains trenched by streams; locally wet, elevation 1200 to 1400 feet above sea-level	Mixed maple, elm, birch, basswood, white pine, fir, spruce and cedar
L'Anse lowland plains.....	64	Soils generally moist or not excessively dry; moderate fertility; sandy loams, loams and silts; not generally excessively stony	Smooth land and rolling land; elevation 600 to 900 feet	Mixed hardwoods; fir, spruce, cedar, white pine
Keweenaw stony highland.....	65	Thin stony soils on bed rock; rock outcrop and barren cliffs and ledges; valleys of stony loams and sandy loams; swamps, peat and muck and wet sandy soil	High rock ridges, steep slopes; stony, rough, pitted valleys; valley swamps	Mixed hardwood-conifer forest
Rexford pine plains.....	66	Loose yellowish sands; dry, acid, low in productiveness	Plains, level to moderately undulating; pitted	Norway, jack and white pines
Isle Royale.....	67	Soils probably fairly fertile, but thin or excessively stony; local bodies of sands and peat	Stony rock ridges and knobs; complementary and parallel sandy valleys; lakes	Mixed conifers with admixture of hardwoods

ON THE DISTRIBUTION OF VOLCANOES IN JAPAN *

AKIRA WATANABE

THE investigations that have been taking place in Japan for the last fifty years have made possible a fairly exact study of the distribution of volcanoes. The present study is an attempt to learn their general distribution, chiefly from the geomorphological point of view. The method used is first to classify the volcanoes according to their form and then to locate them areally, with symbols indicating their character.

The classification is done by keeping the three important geomorphic factors in mind: initial form, stages of dissection and size.

I. CLASSIFICATION

A. Initial forms. — Because of the ways of formation and consequently because of their visible forms, the following classification is adopted in this study:

1. Strato volcano (Konide);
2. Massive volcano (Tholoide and Belonite);
3. Shield volcano (Aspite);
4. Lava plateau (Pedionite);
5. Maar and Homate.

Although caldera represent not the constructional forms of volcanoes, but merely the destructional form through explosion or depression, they are considered here. This form is so conspicuous that it should not be neglected. Perfect kettle depressions that have no direct relation to volcanic bodies are frequently found in volcanic regions. These have been considered caldera in this study because they are sure negative expressions of volcanism.

* Paper from the Department of Geography of the University of Michigan.

B. Stages of dissection. — These are divided as follows:

1. Young volcano which has wide initial surface;

2. Dissected volcano of early maturity, which, although it has lost some parts of the initial surface, still retains some;

3. Maturely dissected volcano, which has lost the greater part of the initial surface.

In addition to these types, there is the old volcano, but it is hardly recognizable geomorphologically.

Many varieties of sequential (erosional) forms of volcanoes are found because of the differences of their initial forms and sizes. For example, the top of a gigantic volcano shows a more advanced stage of dissection than the flank. This is due chiefly to the hard weathering in the high altitude and to the steep slopes. The dissection of a flat volcano is caused chiefly by insequent streams. Thus the top or the central part of the volcano is better preserved than the flanks.

C. Sizes. — The size of a volcano is determined by its mean basal diameter. There are six groups of volcanoes classified according to the size of the basal diameter: (1) less than 2 km.; (2) between 2 and 5 km.; (3) between 5 and 10 km.; (4) between 10 and 20 km.; (5) between 20 and 35 km.; (6) more than 35 km.

II. THE FACTS OF DISTRIBUTION

Without counting parasitic and central cones, well over five hundred volcanoes are found in this insular empire. There are records of historic eruptions for just sixty of them. Most of the famous ones are strato volcanoes. The typical shield volcano is very rare and a massive volcano occurs chiefly as a parasitic cone.

A mere glance at the distribution map (Map 42) is enough to show the general accordance of the arrangement of the volcanoes with the major trends of the insular arc. Five salient lineaments of volcanic arrangement are apparent.

A. Chishima and eastern Hokkaido. — This district applies to that lineament which enters into Chishima (Kurile Islands) from the volcanic region of Kamchatka at Alaido Island, stretches over 1400 km. and terminates in the central part of Hokkaido Island. This stretch of volcanoes makes an arc with the convex

Map 42. Distribution of volcanoes in Japan

side toward the Pacific Ocean. It is suggested by the sea charts that they are resting upon the submarine range. A closer analysis of their distribution will show that they are grouped into many minute lineaments that are arranged in *en échelon* pattern. This pattern becomes clearer as we go southwestward. Most of the volcanoes are of the strato type, and, in spite of the lack of historical records, thirteen active ones are known in this region. Some of them are always smoking. Caldera characterize some of the volcanic bodies, giving them picturesque lakes or sheltered harbors.

B. Western Hokkaido and the northeastern part of Honshu. — Stretching from the volcanic group of the southwestern Hokkaido south to the central part of Honshu is another important volcanic region. At its southwestern part it intersects another row of volcanoes making a clear cusp. The characteristic pattern of the distribution within this region is the separation into small compact agglomerations, occurring at more or less equal distances.

Most of the volcanoes in this area are in Tertiary deposits. The mountain lands of Abukuma and Kitakami are chiefly composed of ancient rocks and the volcanoes are rather small. With the exception of a row of volcanoes upon the central range of northeastern Honshu, most of the volcanoes are in depressed areas. Caldera are found in the northern part. Eighteen of them are active and their density of distribution is as great as those in the Chishima district.

C. The central part of Honshu and the southern islands. — A row of volcanoes stretches along the lowlands of Fossa Magna southward far into the southern Pacific. The celebrated volcano, Fuji, is in this region. Compact groups of volcanoes are also found here. Of the fifteen which have historic records of eruption, three are in Honshu and twelve in the southern islands. Submarine eruptions are sometimes reported in this area.

D. Southwestern Honshu and Shikoku. — Fewer volcanoes are found in this region than in the others. All of them are confined to the inner zone, and no volcano is reported from the outer zone or the "Kumakii Bergland." Even these few volcanoes are, in large part, small and massive; none is active in this region.

E. Kyushu and Lu-Chu islands. — Stretching from the vast volcanic region of northern Kyushu southward into the Daiton volcanic group in Taiwan, many fresh volcanoes are found. Fourteen of these are active. There is no volcano in this part of the outer zone. Compact groups of the same initial form are characteristic of the distribution pattern.

Lastly, it may be added that all the known volcanoes of Japan that are still recognized as such from the present form have accomplished their latest constructional processes in the Quarternary age. None of the volcanoes has ever been reported as covered by Tertiary deposits. Even some of the large ruined volcanoes are resting in unconformity upon the youngest Tertiary formations.

University of Michigan

SURFACE GEOLOGY OF LUCE COUNTY, MICHIGAN

STANARD G. BERGQUIST

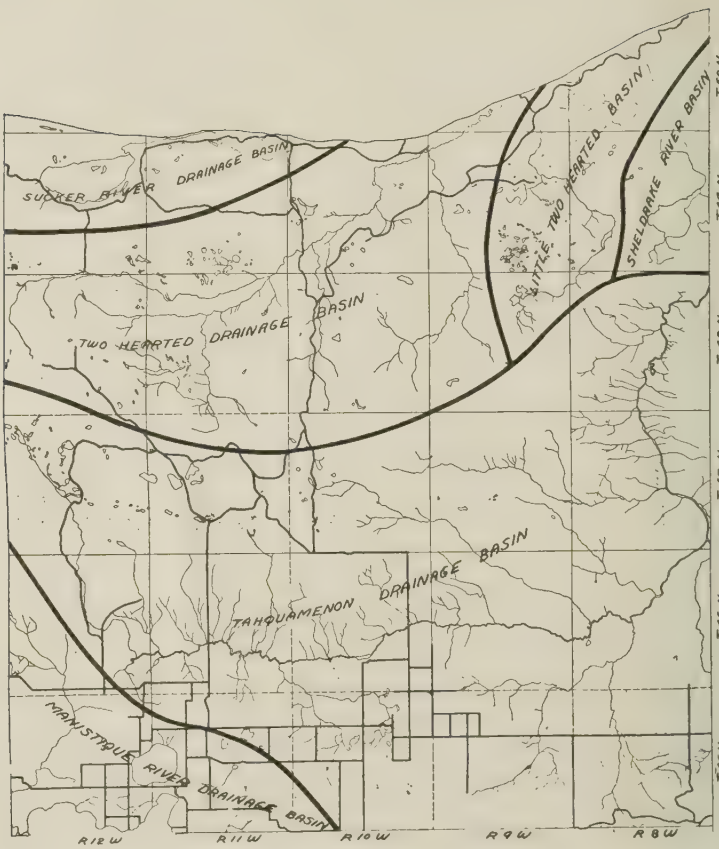
THE geological work in Luce County was carried on during the summer of 1929, in connection with the activities of the Land Economic Survey of the state of Michigan. Luce County lies within the region which was covered by a re-advance of the Superior lobe of the Labrador ice-sheet, late in the Wisconsin stage of Pleistocene glaciation. The lobation of this ice-sheet, which moved down from the northeast, was induced by the basin of Lake Superior.

The glacial surface, deposited in the retreat of the ice from the area, was subsequently invaded by the waters of Lake Algonquin which, at its highest stage, spread out over practically the entire county. Some of the older surface features were thus reworked by the waters of this glacial lake, with the result that in places the relief was modified and greatly subdued.

The differential uplift, which occurred north of the hinge-line during Algonquin times, caused the Lake Superior region to be raised several hundred feet above its normal plane. This change in elevation was responsible for extensive modifications in drainage, which are now reflected in the broad, swampy and poorly drained tracts bordering the principal rivers in the area. (See Map 43.)

DRAINAGE

The most extensive single feature in the county is represented in the numerous swamps and lowland tracts which have developed along the drainage ways of the main rivers and streams. (See drainage map, 44.)



Map 43. Drainage basins in Luce County

The Tahquamenon River

Of the 934 square miles included in the county, 480 square miles, or slightly more than 50 per cent of the total area, are drained by the Tahquamenon River.

This river headwaters in a group of glacial lakes in T. 47 N., R. 12 W., and, from a point 10 miles south of its source, flows

MICHIGAN
DEPARTMENT OF CONSERVATION
LAND ECONOMIC AND GEOLOGICAL SURVEYS
COOPERATING
GEOLOGICAL MAP
SHOWING
SURFACE FORMATIONS
OF
LUCE COUNTY
L A K E
P R I O R

Map 44

eastwardly across the county, thence north and out of the area, in the northeast corner of T. 48 N., R. 8 W. Its waters are finally discharged into Whitefish Bay, near Emerson, in Chippewa County.

For the greater portion of its course, the river leads through an extensive swampy lowland, poorly drained, and with a floor made up of areas of sand, silt, clay and muck of variable depth and surface extent (Pl. LIX, Fig. 1).

In a distance of 50 miles above the Upper Falls the river has a total fall of 26 feet, or a gradient of practically six inches to the mile. Its flow is sluggish and the discharge is irregular, depending upon the season. The confining walls of the channel are low and in flood stages the overflow is extremely great. The channels of most of the tributaries are likewise poorly confined and ramify through swampy tracts for considerable distances upstream, spreading the waters out into broad, shallow sheets during the rainfall periods.

At the Upper Falls, Section 11, T. 48 N., R. 8 W., the Tahquamenon River flows over a ledge of Cambrian sandstone (Pl. LIX, Fig. 2) and for some distance below passes through a gorge of similar material (Pl. LIX, Fig. 3). The elevation at the falls, as determined by Wisler by means of levels, is 694 feet. This area of bed rock, one of the few which are exposed, is the most extensive outcrop in the county.

The divide between the Tahquamenon and Manistique drainage basins lies near the line of Luce and Delta counties, just to the north of the station of Danaher, on the Duluth South Shore and Atlantic Railroad. The watershed here stands at an altitude of 720 feet, or approximately 120 feet above the level of Lake Superior. During Algonquin times, in the development of the Great Lakes, the narrow strait to the north of McMillan connected the Tahquamenon and Manistique drainage systems across this divide, and provided a southward passage from the Lake Superior to the Lake Michigan basins. This outlet was abandoned when the level of Lake Algonquin receded to a plane below that of the divide.

The Tahquamenon Valley and much of its swampy border

occupy an old preglacial channel, which apparently had been scoured quite deeply before it was invaded by Pleistocene glaciation. The southern margin of the swamp in Luce County is confined by the northward facing Niagaran escarpment, the steep face of which no doubt was here at least partially cut by the preglacial river which flowed through the basin. There seems to be a definite alignment between this escarpment and basin and that of Green Bay Peninsula, which is a continuation of the escarpment and the Green Bay depression, farther south in Wisconsin (Pl. LX, Fig. 1).

The differential movement, which was in progress during the latter portion of Algonquin times, caused the northeastern part of the lake to be strongly uplifted. This activity raised the ledge of Cambrian sandstone at the Upper Falls of the Tahquamenon River, causing the upstream gradient to be greatly decreased and the velocity of the river to be lowered. The waters of the river were thus forced to spread out over the bordering lowland tracts and produced the swampy condition which now exists over such a large portion of the region.

This same uplift movement had a counter-effect upon the Manistique drainage, which is carried southward down the gentle back slope of the Niagaran cuesta. The headwater area of this basin was somewhat rejuvenated and the velocity and erosive power were decidedly increased, with the result that the postglacial channel has become more deeply scored, and swampy tracts are less extensively developed than in the Tahquamenon basin.

In many places a narrow sandy plain extends along the south border of the Tahquamenon swamp with morainic features setting in at 750 to 800 feet above sea-level. McMillan and Newberry each stand on such a plain.

The Tahquamenon swamp, as well as the majority of the other lowland areas in the county, is studded with an unusually large number of sandy ridges. These range in size from merely a score of feet to several miles in length, and from a few feet to twenty feet and more in height. They seem to run in somewhat definite trends through the swamp, and occasionally are to be found rather high

up on the slopes of moraines along the borders of the lowland tracts (Pl. LX, Fig. 2).

In general, the ridges are made up of a very fine textured quartz sand, with grains which are slightly subangular. In many areas they are superimposed upon a gravelly floor and may even contain coarse material throughout. The fine sandy ridges appear as though they may be of aeolian origin and possibly represent marginal dunes. Many of them have the characteristic crescent shape so common to dunes. The gravelly areas, however, apparently represent deposits formed under water and laid down as offshore bars along the margins of the retreating waters of Lake Algonquin. It seems probable that a combined lacustrine and aeolian activity may explain the origin of the ridges, but nothing definite can be ventured until more detailed studies are made of them.

The pine-covered sandy ridges are of importance from the fact that they afford more or less connected routes for travel through an otherwise almost impenetrable tangle of swamp vegetation, and at the same time furnish suitable sites for temporary camps.

The Two Hearted River

This river heads in a series of swamps to the north of the middle morainic system in T. 48 N., Rs. 11 and 12 W.; it flows in a northeasterly direction through swamps and sandy plains and enters Lake Superior in T. 50 N., R. 9 W. It drains an area of 230 square miles and for much of its upper course leads through an extensive swampy lowland. This drainage system, like that of the Tahquamenon River, suffered a reduction of gradient and a retardation of velocity during the differential uplifts which affected the region. There was, however, no rock barrier to hold the waters back and to prevent a lowering of the channel; consequently, the swampy tracts are confined principally to the headwater area. In the lower half of its course the river flows through a level sandy lake plain, and for a distance of about five miles back from its mouth follows parallel with the shore of Lake Superior, where it is held back by a row of low sand dunes. In much of its course through the old lake plain the river has cut its channel quite deep into the loose sand and is lined with steep-cut banks,

the slopes of which are controlled by the angle of repose of the material.

The Manistique River drainage basin

In the southwest corner of the county, in the district of the Manistique lakes, is an area of about 80 square miles which is drained into the southward-flowing Manistique River. The East Branch of Fox River, one of the headwater streams of the Manistique drainage system, taps the region and leads through an extensive swampy tract. The watershed of this drainage system stands at an altitude of 720 feet and is separated from the headwaters of the Tahquamenon River by a very low divide (Pl. LX, Fig. 3).

The Little Two Hearted River

This river has its headwaters in the group of Two Hearted lakes in T. 48 N., R. 9 W., and drains an area of approximately 75 square miles in the northeast portion of the county. It flows generally north, across a sandy lake plain, and enters Lake Superior in T. 50 N., R. 9 W., a few miles to the east of the outlet of the Two Hearted River.

From near its source, the river swings with a broad sweeping curve in a northeasterly direction around a group of lakes located in the SE. $\frac{1}{4}$ of T. 49 N., R. 9 W. It is very probable that this part of its course was at an earlier date controlled by the border of a moraine, which has since been cut down by the combined erosional activity of the Two Hearted and Little Two Hearted rivers. The numerous water-filled basins in the region between the two rivers, together with the small scattered morainic fragments, would suggest that this area was at one time a portion of the inner morainic system.

The Sucker basin

In the northwest corner of the county, there is a deep basin which serves to hold the waters of the Blind and Dead Sucker rivers, which drain an area of 45 square miles (Pl. LXI, Fig. 1). The basin rim is confined on the south by a steep wave-cut escarpment, the crest of which has an altitude of 730 to 750 feet

(Pl. LXI, Fig. 2). The north edge of the depression is bordered by a series of sand ridges and dunes which rise to a height of 75 to 100 feet above the level of the lake.

The two rivers, which occupy the basin, have little or no gradient and are practically stagnant the year around. They are lined with broad swampy borders, but are separated from each other by a low, sandy interfluve, which stands at an elevation sufficiently high to have held in the waters of Lake Nipissing. No definite shore-line development is presented here, however (Pl. LXI, Fig. 3).

The Shelldrake drainage system

In the region of Betsy Lake, in the northeast corner of the county, there is an area of approximately 24 square miles which is drained into the northwest-flowing Shelldrake River. The greater portion of this drainage basin in Luce County borders Betsy Lake in a broad swampy lowland, the south side of which is cut by a series of low, parallel, disconnected sand ridges.

MARGINAL MORAINES

Three distinct marginal moraines cross the county from west to east as separate systems, but merge somewhat brokenly into a more or less single unit in the vicinity of Strongs Station, to the south of Whitefish Bay, in Chippewa County.

The outer moraine

The oldest of these systems follows along to the south of the Tahquamenon swamp and for most of its distance in Luce County lies within the basin to the north of the Niagaran cuesta. Here it has been built up to and above the level of the escarpment, and in places is superimposed upon it. This moraine may be traced from near the axis of the Green Bay lobe about six miles west of the county line in Schoolcraft, and eastward across the south edge of Luce County, as a mass of rolling drift not definitely separated into ridges. Its average width on the west end, where it extends south into Mackinac County, is 8 to 10 miles. It gradually narrows toward the east and where it enters Chippewa County is quite fragmentary and broken (Pl. LXII, Fig. 1).

Throughout much of its course the moraine stands at an altitude between 800 and 900 feet and has a rather strong expression. Along the borders of the big swamp, however, it may in places be as low as 720 feet. The topography of its surface is somewhat irregular, except in the outer borders, and is typically of the knob-basin development. The knobs, for the most part, are not high, and the basins are not especially deep. In the region to the south of McMillan, however, a series of knolls rises to an altitude of over 1000 feet (Pl. LXII, Fig. 2). These high knobs were well above the highest level of Lake Algonquin, which in this region was about 900 feet above sea-level. Some of the basins are fairly large; the one occupied by Manistique Lake has an area of approximately 15 square miles.

The material which makes up the drift of the outer moraine is largely sandy in character, but is locally admixed with heavier clay. In general, the drift is loose-textured and well drained, the heavier phases being found in the vicinity of Manistique Lake. In the more strongly developed portions of the inner border of the moraine, erratics are very numerous and limestone slabs of local origin are abundantly scattered through the drift. The shaly limestone contains numerous fragments of trilobites of the genus Ogygites, which Ehlers [1] has ascribed to the Collingwood formation. In the more subdued and weaker outer border, the moraine contains a sandy to gravelly drift and erratics are exceedingly scarce upon the surface. These areas have been subjected to modification by the Algonquin waters and the true morainic character has been partially masked by a thin sheet of fine sediment, which was carried down from the higher inner slopes. In places where postglacial streams have been actively engaged in cutting down their channels, the thin veneer of surface sediment has been removed and the underlying glacial drift exposed.

This feature is well illustrated in the morainic area to the south of Newberry. On the strong inner border of the moraine in the vicinity of the state hospital, much bouldery material and many

[1] Ruedemann, R., and Ehlers, G. M., "Occurrence of the Collingwood Formation in Michigan," *Contributions from the Museum of Geology, University of Michigan*, Vol. 2, No. 2.

erratics are inclosed in the drift. To the southward, the boulders become scarce, but cobbly and gravelly material sets in. On the outer border, near the county line, cobbles disappear and give way to a sandy-gravelly drift and the relief is smoothed down to that of a low, even morainic plain.

The drift varies in thickness according to the character of the bed rock topography upon which it lies. Where the rock floor is high and ridged, as it is to the north of Hendricks quarry in the southeast corner of the county, the drift is very thin and the relief is more or less directly controlled by the bed rock surface. In areas where the rock floor has been deeply channeled by water or by glacial activity, the drift is invariably much thicker.

Two recesses occur in the north border of the moraine; one between McMillan and Newberry, and the other four to ten miles east of Newberry. In each of these areas there is a thick deposit of red lacustrine clay. An artesian well recently drilled in the SE. $\frac{1}{4}$ of the NE. $\frac{1}{4}$ Section 8, T. 45 N., R. 10 W., penetrated 80 feet of red clay above 50 feet of sand over 2 feet of gravel before entering bed rock. In the SW. $\frac{1}{4}$ of SW. $\frac{1}{4}$ Section 12, T. 45 N., R. 8 W., artesian water was encountered in a well sunk into 53 feet of lake clay (Pl. LXII, Fig. 3).

The middle moraine

Another morainic system composed of a rolling mass of drift is situated to the north of the Tahquamenon Swamp in Luce County. It represents the eastern end of the high moraine which swings along the shore a few miles south of Lake Superior from Munising to Grand Marais. In Luce County the moraine is somewhat broken in trend, being interrupted in places by swamps and lowland tracts.

This morainic system is similar to the one south of the swamp in that it cannot be separated into distinct ridges. The drift is predominantly loose-textured and sandy, but is locally intermixed with small amounts of clay.

The inner border of this moraine stands at an altitude of between 750 and 800 feet and is quite strongly developed. It is composed largely of a sandy drift interspersed with small amounts

of gravel. The surface is quite rolling and in places irregular, owing to the numerous basins which are inclosed among the knolls. Some of the larger basins contain lakes and swamps, but the smaller depressions are generally dry for the reason that they stand above the water-table. Erratics and boulders are scattered widely through the drift. Limestone slabs and fragments are present in certain areas, but constitute a relatively small proportion of the composition of the deposit. Limestone blocks are conspicuous in the shore bluff to the south of Cold Spring in Section 6, T. 47 N., R. 10 W., but no calcareous material was found to the north of this belt.

The outer border of the moraine is relatively low and exceedingly weak. It breaks into the Tahquamenon swamp at altitudes ranging from 700 to 720 feet. The drift is largely a mixture of sand and gravel, with only occasional erratics exposed at the surface. The relief is generally smooth and unbroken, except where the surface has been seared with drainage creases, which have been cut down into the unmodified drift below.

Like its counterpart to the south of the swamp, this moraine was practically inundated by the waters of the highest Lake Algonquin. A small area, covering merely a few square miles in the SW. $\frac{1}{4}$, T. 48 N., R. 12 W., and the NW. $\frac{1}{4}$ T. 47 N., R. 12 W., in Luce County and extending over into the southeast corner of T. 48 N., R. 13 W., in Alger County, stands at an altitude of approximately 1000 feet and was well above the level of the Lake Algonquin waters.

The inner moraine

The latest moraine, developed by the withdrawal of the ice-sheet from the eastern end of the Northern Peninsula, stands in the sandy lake plain a few miles to the south of Lake Superior. It is rather fragmentary and in much of its distance is difficult to trace, being broken by low areas of swamp and sandy lake bed. The westernmost fragment of this sytem lies to the south and west of the Sucker River basin in the western portion of T. 49 N., R. 12 W., where it extends for a few miles west into Alger County. Another fragment continues eastwardly from the east end of

the Sucker River basin through T. 49 N., R. 11 W., and into R. 10 W.

In most of this latter section, the inner border of the moraine is quite distinct, being marked by a fairly conspicuous shore-line, and rises to an elevation of 730 to 750 feet (Pl. LXIII, Fig. 1). The weak outer border, on the other hand, is not so well defined and merges more or less indefinitely into the sandy plain to the south. The topography of this morainic fragment is generally weak and quite subdued, but is broken by occasional low knobs and shallow depressions. The drift is very sandy, light and loose-textured, with scattered patches of gravel and cobble.

East of the Little Two Hearted River, in the northeast corner of the county, is another fragment of this moraine. Here the feature is made up of an undulating mass of drift with no ridge development. The till is sandy to clayey in texture with numerous boulders and erratics scattered through it. This portion of the moraine has a very strong relief and is marked by a characteristic swell and sag topography. It stands at an elevation much higher than its counterparts to the west, and has an altitude ranging up to 800 feet (Pl. LXIII, Fig. 2).

The general trend of this innermost morainic system would suggest a north-northwest recession of the ice border from the southeast end of Lake Superior. It is the youngest glacial deposit in this portion of the peninsula.

OUTWASH PLAINS

Outwash plains constitute a relatively small portion of the surface area in Luce County. They are confined entirely to the south border of the moraine, which lies to the north of the Tahquamenon swamp.

An outwash apron of sandy-gravelly material occupies a re-entrant of the moraine in Townships N. 46 and 47, R. 11 W., or directly across the swamp north from McMillan. Near its inner edge the plain is smooth and generally unbroken and presents the typical outwash surface character. It consists of coarse, cobbly and gravelly material, which apparently was washed down from the slopes of the bordering moraine to the north (Pl. LXIII, Fig. 3).

The south half of the apron is rough and in places deeply trenched and pitted. Except for the character of the material and the absence of erratics, the outer border does not differ materially from the surrounding morainic areas. It is quite probable that the apron was formed upon a more rugged morainic topography during a recession of the ice border, which was marked by successive halts of short duration. The apron did not receive a sufficient amount of sediment to fill in completely the depressions and smooth out the irregularities, but was built up in a series of steps from south to north as the ice retreated.

To the west of the morainic spur which borders this outwash apron, in the western half of T. 47 N., R. 12 W., and extending southward into T. 46 N., R. 12 W., is another outwash plain. This is merely the east end of the extensive outwash area which fronts the Munising Grand Marais moraine in Alger County and borders the north edge of the Manistique–Tahquamenon swamp in Schoolcraft County. It stands at an altitude of about 800 feet above sea-level or 80 feet above the level of the Tahquamenon swamp.

This outwash plain is composed of material of very loose structure and of a sandy to gravelly texture. It is very well drained and contains but few areas of swamps and undrained depressions. The relief is smooth and regular except at its outer borders, where it is trenched by streams flowing down the slopes into the Tahquamenon drainage basin.

OLD SHORE-LINES

The highest Algonquin shore feature

With the exception of two rather widely separated areas, covering a total of about three and one-half square miles, Luce County was completely inundated during the highest stage of Lake Algonquin. The waters of this lake stood at an altitude of slightly more than 900 feet and only those morainic knobs which rise above this level were exposed as small islands. Many of the higher moraines, and portions of bordering outwash plains as well, standing at an elevation slightly less than 900, were merely covered by shallow water of the lake.

The highest shore work in Luce County is to be found in the

morainic region to the south of the village of McMillan, where it is evident up to an altitude of 870 feet. This places the highest Algonquin level about 30 feet too low to fit the plane at Rexton to the southeast, as determined by Leverett.[2] It is also more than 30 feet below the Algonquin level south of Grand Marais, to the northwest, as determined by aneroid leveling.

Leverett [3] suggests that this discrepancy may be accounted for if the ice persisted as a stagnant mass in the low places to the north and covered the district around McMillan to a later time than at Rexton, so that the highest beach at Rexton is not represented here.

The highest Algonquin shore may be followed somewhat interruptedly along the north edge of the outer moraine, which borders the south side of the Tahquamenon swamp, all the way from. McMillan to Newberry. It maintains its elevation fairly well for much of this distance, but the features are not sharply defined. It loses elevation a mile south of Newberry and cannot be definitely traced beyond Section 6 in T. 45 N., R. 9 W.

Lower Algonquin shore-lines

The drainage changes, which were initiated by the withdrawal of the ice-sheet from the Lake Superior basin and were further influenced by the differential uplift in this region, caused the waters of Lake Algonquin to recede. Four successive changes in level are evidenced by the wave-cut terraces which stand between the highest Algonquin and the non-glacial Nipissing shores.

A rather poorly defined shore standing at an altitude between 795 and 805 feet marks the boundary between the moraine and the sandy lake plain to the south of the village of Newberry. It extends from the northwest corner of Section 35 in T. 46 N., R. 10 W., for a distance of about six miles to the SW. $\frac{1}{4}$ of Section 10 in T. 45 N., R. 9 W., where it seems to disappear. To the south of Newberry it is marked by a strongly developed wave-cut terrace with a gravelly strand, but this feature becomes more obscure to the south and east.

[2] Leverett, Frank, *Moraines and Shore Lines of the Lake Superior Region, U. S. Geol. Surv. Professional Paper 154–A*, 1929, p. 67.

[3] *Ibid.*

Another shore feature, with an altitude between 795 and 810 feet, borders the north edge of the middle moraine. It may be traced as a wave-worn cliff for a distance of 16 or more miles, from the northwest corner of Section 7 in T. 48 N., R. 12 W., southeastwardly to the southwest corner of Section 5 in T. 47 N., R. 10 W., where it breaks off into the swamp and loses its identity. The strongly developed shore cliff, together with the presence of numerous small, sandy to gravelly bars perched rather high up on the slopes of the moraine, would indicate that the waters of the receding Lake Algonquin lingered at this level for quite a long time.

Both these shore features are too high to be correlated with the Battlefield beaches, which stand at an altitude of 720 feet at Mackinac and 765 to 790 feet at Grand Marais, Michigan. They are probably the records of one of the lower members of the upper Algonquin group, which stands slightly above the plane of the Battlefield beaches.

A third level of lower Lake Algonquin is marked by the shoreline, at 715 feet, which follows along on the inner edge of the morainic fragment in the northeast portion of the county. From the southwest corner of this moraine and extending westwardly for about twelve miles, the feature becomes obscure and difficult to follow except by level readings. In Section 18 of T. 49 N., R. 10 W., it continues again as a definite escarpment along the north border of the moraine to the Sucker basin. Here it drops down to its level on the south escarpment wall and goes out of the county in the west-central portion of Section 7 in T. 49 N., R. 12 W.

The lowest level of Lake Algonquin which can be identified in the county more or less parallels the shore of Lake Superior at a distance of from one to two miles south of it. The wave-cut feature of this shore is fairly well developed to the west of the west side of T. 49 N., R. 9 W., and may be followed as a definite ridge to the Sucker basin, where it runs along the south escarpment. To the east of this line, however, it is fragmentary and difficult to trace. The plane of this shore feature stands at an altitude of 670 feet and may possibly correlate with the Fort Brady beach, which at Grand Marais has an altitude of 674 feet.

The Nipissing shore

The Nipissing shore in Luce County has an altitude of 640 to 650 feet, or approximately 40 to 50 feet above the level of Lake Superior. In general, it follows rather closely the shore of the present lake, and in much of its extent is marked by a pronounced escarpment. The shore features of Lake Nipissing are more continuous and more strongly developed than are those of the Algonquin group. This is probably due to the fact that the waters remained at the Nipissing level for a much longer period. Sandy and gravelly bars are found scattered along this shore and in places where the slopes were steep, wave-cut terraces and cliffs are prominent (Pl. LXIV, Fig. 1).

SANDY LAKE PLAINS

Sandy stretches of old lake beds are scattered quite widely in the swamps of the county. The most extensive area of lake plain is to be found north of the parallel crossing the north edge of T. 48 N. This plain stands at an altitude ranging from 640 feet on the crest of the Nipissing beach to about 800 feet in some of the more highly elevated sections. Its surface is generally smooth and regular except where it has been pitted with lakes and other depressions or where rivers have cut channels into the unconsolidated sand (Pl. LXIV, Fig. 2).

This plain was formed as a result of wave action in the receding waters of Lake Algonquin. Much of the sandy and gravelly material which constitutes the area was contributed by the inner moraine and no doubt has been spread out over the low-lying inner extension of this same feature.

SAND DUNES

Most of the sand dunes of the county are confined to the Lake Superior shore in Townships 49 and 50 N., R. 12 W., and T. 50 N., Rs. 8 and 9 W. Those in Ranges 9 and 12 W. have been built up as a series of tenuous ridges in post-Nipissing times. They are fairly well covered with vegetation and for the most part stationary (Pl. LXIV, Fig. 3). The dunes in R. 8 W. stand upon the Nipissing

shore and in all probability were blown up by wind action from the Nipissing beaches. These dunes are likewise mostly grown over with vegetation and quite definitely fixed. Small isolated patches of drifting sand are found widely scattered along the present shore of the lake, a short distance back from the strand. This material is being whipped up from the present beaches and will in time develop into definite dune areas.

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FIG. 1. Tahquamenon River above the Upper Falls

FIG. 2. The Upper Falls of the Tahquamenon River

FIG. 3. Wall of Cambrian sandstone in the gorge below the Upper Falls

FIG. 1. Looking north across the Tahquamenon swamp from the crest of the moraine, Section 31, T. 45 N., R. 8 W.

FIG. 2. Sandy ridge bordering swamp in Section 33, T. 45 N., R. 10 W.

FIG. 3. Swampy lowland bordering the East Branch of the Fox River, west of Danaher

FIG. 1. Looking north across the Sucker basin

FIG. 2. Shore cliff and escarpment, south rim of the Sucker basin

FIG. 3. The Blind Sucker drainage basin

FIG. 1. Morainic hills one mile east of Danaher (in the background)

FIG. 2. Morainic topography south of McMillan

FIG. 3. Clayey lake plain in recess east of McMillan

FIG. 1. Shore-line escarpment south of Whorls Camp in Section 9, T. 46 N., R. 11 W.

FIG. 2 Kettle basin in water-worked inner moraine, south of Perch Lake

FIG. 3. Sandy outwash plain, east of Murray Lake, T. 47 N., R. 11 W.

FIG. 1. East end of the Blind Sucker basin, showing the Nipissing shore to the right

FIG. 2. Sandy lake plain south of Muscalonge Lake. Note the deer in the background

Fig. 3. Sand dunes north of the Sucker basin in the northwest portion of the county

A REVIEW OF THE STRATIGRAPHY OF THE SAGINAW FORMATION *

WILLIAM A. KELLY

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Introduction
Previous work
Origin of the name "Saginaw formation"
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Stratigraphic position
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INTRODUCTION

THIS paper is intended as a review of present knowledge of the stratigraphy of the Saginaw formation of Michigan. Brief summaries of those portions of publications which deal with the stratigraphy of the coal-bearing beds are included; they show the varying views held by different workers from the time of Douglass Houghton to the present. An attempt is made to define the upper and lower limits of the Saginaw formation. The varying lithology of the beds between these limits is described, and emphasis is laid upon what seem to be salient characters which may prove of value in correlation. The evidence bearing upon the age of these beds is very meager. An outline to guide future efforts is suggested.

PREVIOUS WORK

The first explorations for coal were made in 1835 west of Jackson, but it was not until a few years later that geological investigation was started.

* Published by permission of the state geologist of Michigan.

1838. — Douglass Houghton, in his first report [1] as state geologist, mentions some of the outcrops of the Coal Measures within the state of Michigan. He noted the presence of fossil plants in beds exposed in the quarries at Jacksonburgh (Jackson) and associated these with the coal. He also mentions the occurrence of a stratum of limestone near Shiawassee town (Corunna), which was similar to limestone outcropping near Jacksonburgh. This latter occurrence of limestone is not mentioned, however, by later writers. It was Houghton's belief at this early date that the Coal Measures underlay an area extending to the northern part of the Lower Peninsula.

1839. — A second report [2] includes brief descriptions by D. Houghton and C. C. Douglass of the occurrence of sandstone and coal outcrops in Ingham, Eaton and Jackson counties. No attempt is made to subdivide the Coal Measures into smaller groups.

1840. — The work on the Coal Measures had been largely assigned to C. C. Douglass; it is included in a third annual report by Houghton.[3] Douglass grouped the rocks observed in the counties of Jackson, Calhoun, Kalamazoo, Eaton, Ionia and Kent under two divisions, the rocks that overlie the coal, or are associated with it, and those that are below the lowest coal beds. The upper division was composed as follows:

1. Upper coal strata — layers of coal, shale and sandstone
2. Limestone — limited and irregular beds
3. Sandstone — light gray and red
4. Lower coal strata — layers of coal, etc.

The lithologic characters of Douglass' four divisions are described in stratigraphical order. Though he mentions the plant fossils of the sandstone above the lower coal as a criterion of its age, he mistakes the limestones exposed at Bellevue as a part of his "coal-

[1] Houghton, D., "Report of the State Geologist," *Documents of the House of Representatives of the State of Michigan*, Document 24, pp. 276–316. 1838.

[2] Houghton, D., "Second Annual Report of the State Geologist," *Documents Accompanying the Journal of the Senate of the State of Michigan*, Document 12, pp. 264–391. 1839.

[3] Houghton, D., *ibid.*, Vol. 2, Document 7, pp. 109–115. 1840.

bearing rocks." The sandstones exposed near Ionia, which are now thought to be equivalent to Woodville, Douglass assigned to a position "intermediate between the upper and lower coal-bearing rocks."

1841. — The work on the Coal Measures was transferred from Douglass to B. Hubbard, who gives a "geological section" for the then organized counties of the state. In the section of the fourth report [4] dealing with the Coal Measures, Hubbard changed Douglass' subdivision so that the limestone stratum, number two of Douglass' order, is stratigraphically below all the coal beds and the associated sandstones and shales. The limestone, however, is still included under the term "Coal Measures." His division reads as follows:

Upper coals and shales
Included sandstones
Lower coals and shales
Limestone stratum

The areas underlain by the Lower Coal are described by Hubbard. He believed that the coal beds near the edge of the basin were stratigraphically below the beds exposed near the center, for example, those of Eaton County. The two coal-bearing formations are overlain by red or variegated sandstones. Hubbard estimated the area underlain by the Coal Measures to be about 11,000 square miles.

1861. — Under the reorganized State Geological Survey, Alexander Winchell gives a general sketch of the geology of Michigan in the *First Biennial Report.*[5] The Coal Measures of the earlier workers is subdivided into three divisions, the Parma Sandstone at the base, the Coal Measures (restricted), and the Woodville Sandstone at the top. Descriptions of these divisions are given. The area underlain by the rocks of the middle division is estimated at 6,700 square miles. The location and character of

[4] Houghton, D., "Annual Report of the State Geologist," *Documents Accompanying the Journal of the State of Michigan,* Joint Document 11, pp. 561–565. 1841.

[5] Winchell, A., *First Biennial Report of the Progress of the Geological Survey of Michigan, embracing observations on the Geology, Zoölogy and Botany of the Lower Peninsula.* 1861.

natural rock sections throughout the state are described. Descriptions of the sections exposed in several mine shafts are included. The part dealing with the Coal Measures, or middle division, is concluded with a generalized tabular list of the beds which Winchell thought to be typical of the stratigraphy. It was his belief that one persistent coal seam ran through the entire Coal Measures. His estimate of their thickness is low.

1876. — The three divisions proposed by Winchell were not used by C. Rominger.[6] The latter took exception to the use of "Parma Sandstone," since he did not believe in regularity of sequence of the strata of the Coal Measures. Under the term "Coal Measures," he included all strata above the Bayport limestone. He estimated the thickness of the coal-bearing series to be 300 feet. The outcrops near Jackson, Grand Ledge, Owosso, Rifle River, as well as several localities, are described in detail. Descriptions of natural sections, or sections exposed in mine shafts close to outcrops, are tabulated and illustrate the variable succession of strata from one locality to another. The presence of *Lingula* shales are noted, but no effort is made to use that brachiopod for correlation purposes. A geological map of lower Michigan accompanies the report.

1882. — A short, but comprehensive, report on the Coal Measures appears in one of the reports on the mineral statistics of Michigan.[7] In it C. D. Lawton describes the lithology and attributes a maximum thickness of 300 feet to the formation. The presence of sandstone channels is noted and described. The region underlain by the measures, Lawton says, is a circular area about 50 miles in diameter with very few exposures. Lawton was familiar only with the area south of Corunna, and believed that there was but a single workable seam. He did not believe, however, in the current notion that the presence of sandstone at the surface precluded the finding of coal below.

The later reports of Lawton are concerned chiefly with de-

[6] Rominger, C., *Geology of the Lower Peninsula, Geol. Surv. Mich.*, Vol. 3, pt. 1. 1876.

[7] Lawton, C. D., "Coal," *Annual Report of the Commissioner of Mineral Statistics, Michigan, for 1881.* 1882.

scriptions of individual mines and the progress of the coal-mining industry.

1895. — A. C. Lane gives a brief description of the formations of the Lower Peninsula.[8] He describes the rocks associated with the coal beds as the Jackson Coal Group. The Woodville and Parma are recognized as a part of the Coal Measures, but from the log of a well at Ithaca, Gratiot County, one might infer that Lane restricted the name "Jackson Coal Group" to the beds between the Parma and the Woodville.[9]

1900. — The small Sebewaing Coal Basin is described by Lane.[10] An explanation is put forward to account for sandstone channels known from this district. The presence of faulting on a small scale is noted.

In his discussion of clays and shales of Michigan, H. Ries [11] treats of some of the beds of the Coal Measures. He notes that the shales vary greatly at different mines, but distinguishes three common types, one of which is a so-called fire-clay. Brief descriptions of sections exposed in quarries and mine shafts are given.

1902. — The most comprehensive work on the Coal Measures of Michigan was prepared by A. C. Lane.[12] He states that the report is a compilation of several smaller ones that were published in issues of the *Michigan Miner*. This report, though dealing principally with the subject of coal, contains important information on the stratigraphy of the Coal Measures. The lithology, thickness and probable origin are given. The Michigan Coal Measures are correlated with the Pottsville on the basis of their plant remains, which were identified by David White.[13] Lane Lower Rider, Saginaw Coal, Middle Rider, Lower Verne Coal, proposes a subdivision of the Coal Measures into Lower Coal,

[8] Lane, A. C., *The Geology of Lower Michigan with Reference to Deep Borings, Geol. Surv. Mich.*, Vol. 5, pt. 2. 1895.

[9] *Ibid.*, p. 64.

[10] Lane, A. C., *Geological Report on Huron County, Michigan, Geol. Surv. Mich.*, Vol. 7, pt. 2, pp. 11–12. 1900.

[11] Ries, H., *Clays and Shales of Michigan, Their Properties and Uses, Geol. Surv. Mich.*, Vol. 8, pt. 1. 1900.

[12] Lane, A. C., *Coal of Michigan, Its Mode of Occurrence and Quality, Geol. Surv. Mich.*, Vol. 8, pt. 2. 1902.

[13] *Ibid.*, p. 45.

Upper Verne Coal and Upper Rider, to assist in correlating coal seams in various mines throughout the state. He notes the presence of two marine invertebrate faunas which he is inclined to believe come from the zone of the Verne coals. From the relation of the depth of the base of the Coal Measures to the top of the underlying Napoleon sandstone, Lane inferred that the coal seams and associated sandstones and shales were essentially horizontal and that they did not share in the basinward dip of the older formations.

A report, shorter than that contained in the second part of Volume 8 of the Michigan Geological Survey, was prepared by Lane for the United States Geological Survey.[14] The coal-bearing beds are referred to as the Saginaw formation. The chemical character of the upper and lower coals is contrasted, and the probable significance of fossiliferous marine beds is stressed.

A preliminary report on Arenac County by W. M. Gregory [15] gives a short account of the lithology and the distribution of coal and associated strata in that county.

1904. — Grimsley [16] includes a map showing outcrops of the Saginaw formation in the area northwest of Saginaw Bay. The report, however, does not deal with the Saginaw formation.

1906. — In this year W. F. Cooper's report on Bay County [17] appeared. The stratigraphic division of the Saginaw formation as represented in Bay County is described. An average thickness of 350 feet is given. Cooper follows the example of Lane by subdividing the Saginaw formation on the basis of the coal seams, but adds five new horizons, making twelve in all. The list from the bottom upward is as follows: Bangor Coal, Bangor Rider, Lower Coal, Lower Rider, Saginaw Coal, Middle Rider, Lower Verne Coal, Lower Verne Rider, Upper Verne Coal, Upper Verne

[14] Lane, A. C., *The Northern Interior Coal Field, U. S. Geol. Surv., 22d Ann. Rep.*, Pt. 3, pp. 313–331. 1901.

[15] Gregory, W. M., *Preliminary Report on Arenac County . . ., Geol. Surv. Mich., Ann. Rep. for 1901*, pp. 9–29. 1902.

[16] Grimsley, G. P., *The Gypsum of Michigan and the Plaster Industry, Geol. Surv. Mich.*, Vol. 9, pt. 2. 1904.

[17] Cooper, W. F., *Geological Report on Bay County, Geol. Surv. Mich., Ann. Rep. for 1905*, pp. 135–426. 1906.

Rider, Salzburg Coal, Salzburg Rider. The correlation of the coal seams encountered in drill-holes is apparently carried on in part by their elevations above mean tide-level, chemical and mineralogical characters of the coals or the beds above or below, and also on the relation of some of the coals to marine fossiliferous strata carrying *Lingula* or *Productus* faunas. Descriptions in detail of washouts or preglacial drainage channels are given. Several geological sections are included. The bulk of the latter half of the report is made up of the logs of numerous drill-holes.

In the report of the state geologist for 1905, Lane [18] states that he believes that the Verne coals are the most widespread.

1908. — The report for 1907 contains a brief description by David White [19] of a collection of fossil plants sent to him. White classes the plants as Upper Pottsville. In the latter part of his letter to the state geologist, he says: "I presume it [a specimen at the University Museum from Jackson] is older than coal at Bay City."

1909. — The report of C. A. Davis on Tuscola County contains a description by W. F. Cooper of the Saginaw formation.[20] The boundaries of the formation are given. The average thickness of the formation is stated to be 126 feet. The Parma is not recognized in Tuscola County, although it may be represented by a basal conglomerate. Cooper adds two coal horizons to the list of twelve given in his Bay County report. These two seams are stated to occur above the Salzburg Rider. Cooper says the lower four coal horizons of Bay County occur at higher elevations in Tuscola County.

A summary of the stratigraphy of the Saginaw formation is included in a paper by Lane on the geological section of Michigan.[21] It is a summary of the views expressed by him in the report con-

[18] Lane, A. C., *Geol. Surv. Mich., Annual Report for 1905*, pp. 539–568. 1906.

[19] Lane, A. C., *Geol. Surv. Mich., Ann. Rep. for 1907*, p. 19. 1908.

[20] Cooper, W. F., "Paleozoic Geology," in Davis, C. A., *Report on the Geology of Tuscola County, Michigan, Geol. Surv. Mich., Annual Report for 1908*, pp. 175–196. 1909.

[21] Lane, A. C., *Notes on the Geological Section of Michigan*, pt. 2, *Geol. Surv. Mich., Ann. Rep. for 1908*, pp. 87–89. 1909. "Notes on the Geological Section of Michigan," *Journ. Geol.*, 18 : 426–428. 1910.

tained in Volume 8 of the reports of the Geological Survey of Michigan. Lane does not lay much stress on the fourteen coal horizons proposed by himself and Cooper, but emphasizes the importance of the Verne horizons, which he thinks are associated with fossiliferous beds of shale and limestone. The thickness of the Saginaw is given as 400 feet.

1912. — R. A. Smith,[22] in a report on Michigan coal, summarizes the views of previous workers. He stresses the variable character of the beds of the Saginaw formation and discounts the value of Cooper's subdivisions. Smith gives a probable maximum thickness of more than 600 feet for this formation in the center of the coal basin.

The work of W. M. Gregory [23] on Arenac County describes the distribution of outcrops of the Saginaw formation and the area underlain by it. An outcrop map which accompanies the report shows that most of the exposures are along Rifle River. The thickness of the formation in this county is less than 100 feet.

A very brief summary of the stratigraphy of the Saginaw formation is given by R. A. Smith [24] in a report on oil and gas. Mention is also made of the occurrence of oil in a sandstone lens of this formation at a depth of only 157 feet in a well near Fowlerville.[25]

1915 and following years. — The reports on the mineral resources of Michigan for 1914 and the years following all contain brief references on the subject of coal. Most of the information is of a statistical nature bearing on production and makes no contribution to the stratigraphy of the Saginaw. The sections of the reports which do pertain to stratigraphy are brief and are, as a rule, rewritten parts of former reports. In one of these reports R. A. Smith [26] points out that some wells which penetrate the

[22] Smith, R. A., "Michigan Coal," *Mineral Resources of Michigan, Mich. Geol. and Biol. Surv.*, Publ. 8, Geol. Ser. 6. 1912.

[23] Gregory, W. M., *Geological Report on Arenac County, Mich. Geol. and Biol. Surv.*, Publ. 11, Geol. Ser. 8. 1912.

[24] Smith, R. A., "Oil and Gas in Michigan," *Mineral Resources of Michigan, Mich. Geol. and Biol. Surv.*, Publ. 14, Geol. Ser. 11, p. 31. 1912.

[25] *Ibid.*, p. 165.

[26] Smith, R. A., "Coal in Michigan," *Mineral Resources of Michigan*, pt. 2, *Non-metallic Minerals, Mich. Geol. and Biol. Surv.*, Publ. 19, Geol. Ser. 16, p. 251. 1915.

Saginaw formation near the center of the basin indicate the absence of both coal and black shales there. This is interpreted as a further proof of the variability of the beds of the Saginaw formation.

A report on the shales within the state by G. G. Brown [27] includes a map showing exposures of shales of the Saginaw formation.

ORIGIN OF THE NAME "SAGINAW FORMATION"

The Saginaw formation has also been referred to as the "Coal Measures," the "Coal-bearing Measures," the "Jackson Coal Group," the "Jackson Series," and even as the "Pottsville." In most cases these terms have been quite loosely used. Thus C. C. Douglass, in his report to the state geologist,[28] included in "Coal Measures" rocks now recognized as Mississippian, and, later on, C. Rominger [29] used the same term to apply only to rocks younger than the Bayport limestone, which today is considered to be the youngest formation of the Mississippian represented in Michigan. On the other hand, Winchell,[30] in a report antedating Rominger's, restricted the name "Coal Measures" to the beds between the Parma and the Woodville, groups which Rominger did not recognize. The name "Coal Measures" itself had been and is still used, with an entirely different significance.[31] It was probably for such a reason that Lane [32] used the name "Jackson." This name in turn, however, was replaced because it was preoccupied by a Tertiary formation in Mississippi.[33] Accordingly, Lane [34] suggested applying the name "Saginaw" to the coal series, because it was a characteristic Michigan name. It has come into general

[27] Brown, G. G., *Clays and Shales of Michigan and Their Uses, Mich. Geol. and Biol. Surv.*, Publ. 36, Geol. Ser. 30, p. 192. 1924.

[28] Houghton, D., p. 101 of work cited in note 3.

[29] Rominger, C., *op. cit.*, 3 (pt. 1) : 122.

[30] Winchell, A., *op. cit.*, p. 114.

[31] Willis, B., *Index to the Stratigraphy of North America, U. S. Geol. Surv., Prof. Pap. 71*, p. 425. 1912.

[32] Lane, A. C., *Geol. Surv. Mich., Report of the State Board of Geological Survey for 1891 and 1892*, p. 66. 1893.

[33] Weeks, F. B., *North American Geologic Formation Names, U. S. Geol. Surv., Bull. 191.* 1902.

[34] Lane, A. C., "Suggestion from the State Geologist," *Michigan Miner*, 3 (No. 10) : 9. 1901.

MAP 45. Michigan coal basin, showing location of outcrops (see next page for legend)

used since 1901, when Lane employed it in connection with his report on the Northern Interior coal field for the United States Geological Survey.

The name is still subject to some discussion. According to Mr. R. Newcombe [35] of the State Geological Survey, the well-

[35] Newcombe, R., personal communication.

LEGEND FOR MAP 45

Data compiled principally from publications of the Michigan Geological Survey. References are to authors mentioned in the text.

No.	Locations	References
1	Rifle River, above Omer	Gregory, 1911
2	Rifle River, below Omer	Gregory, 1911
3	Cass River, near Tuscola	Winchell, 1861
4	Flint River, 1½ miles below Flushing	Ries, 1900
5	NE. ¼, Section 35, Flushing Township	Winchell, 1861
6	Two miles northeast of Corunna	Brown, 1926
7	Grand River, Section 23, Ionia Township	Rominger, 1876
8	Grand River, below Grand Ledge	Rominger, 1876
9	Near Grand Ledge	Rominger, 1876
10	Near Williamston	Brown, 1926
11	Highway M–127, Section 10, T. 2 S., R. 1 W.	Unpublished
12	Portage River, east of confluence with Grand River	Rominger, 1876
13	Near Woodville mine, Section 25 (?), T. 2 S., R. 2 W.	Winchell, 1861
14	Roadside, SW. ¼, Section 27, T. 2 S., R. 2 W.	Unpublished
15	NW. ¼ of NW. ¼, Section 29, T. 2 S., R. 2 W.	Winchell, 1861
16	NE. ¼, Section 19, T. 2 S., R. 3 W.	Winchell, 1861
17	NW. ¼, Section 12, T. 2 S., R. 4 W.	Unpublished

drillers in the Saginaw oil field apply the term "Saginaw Sand" to a petroliferous horizon in the Traverse formation. This usage, however, yields in priority to Lane's.

AREAL DISTRIBUTION

The area underlain by the Saginaw formation is practically coextensive with the Michigan coal basin. Lane [36] briefly describes the extent of the coal field as being from "Jackson County on the south to Roscommon County on the north, and from Tuscola County on the east to Kent County on the west. It embraces an area of 7500 square miles." This area is entirely separated from the Pennsylvanian areas in the states to the south. It is probable that there were only brief periods of communication between the Michigan and adjoining basins.

The formation outcrops in isolated localities, principally within the counties of Arenac, Tuscola, Genesee, Shiawassee, Eaton, Ingham and Jackson. The outcrop localities mentioned in reports

[36] Lane, A. C., p. 313 of work cited in note 14.

of the Michigan Geological Survey are indicated on the accompanying map (Map 45). The scarcity of outcrops is due to the thick accumulation of drift material, which has an extensive distribution in the state of Michigan. This drift is only rarely trenched through by streams.

The lack of outcrops is partially compensated for by the large number of mine-shafts and drill-holes which have been put down in the state. Many of the old mine-shafts and workings have caved in or are flooded today, however, and as a consequence the information they might have yielded has been lost. The data contained in the logs of numerous drill-holes are ordinarily of an incomplete character and of little value from a stratigraphical point of view.

STRATIGRAPHIC POSITION

The Parma sandstone, which has a conglomeratic facies at times, lies beneath the Saginaw formation. From a study of well-sections showing both the Parma and Saginaw, it appears to one that the boundary is at the contact between the lower shales of the Saginaw and the upper white sandstone of the Parma. Cooper [37] doubts the presence of the Parma in Tuscola County. In cases such as this the lower boundary of the Saginaw formation is the erosional unconformity at the top of the Bayport, or the underlying Michigan formation. In several instances the Saginaw formation may rest directly upon the Napoleon sandstone.[38] The formation rests, therefore, upon an uneven surface which probably resulted from the differential erosion of Mississippian and early Pennsylvanian strata. The irregularities of this pre-Saginaw surface are reflected in the beds above, giving them an undulatory structure.

LITHOLOGIC CHARACTERS

The Saginaw formation is composed of material of both marine and terrestrial origin. Undoubted marine rocks are subordinate in amount and consist of thin beds of argillaceous limestone and blue and black shales. *Lingula* faunules occur in the shales, and

[37] Cooper, W. F., *op. cit.*, p. 190.
[38] Lane, A. C., p. 83 of work cited in first reference in note 21.

richer faunules are known from the calcareous beds. Terrestrial sediments, which make up the greater part of the formation, are represented by several types of sandstones, shales and coal. Many of the beds contain recognizable plant fragments which throw light on the age of sections of the Saginaw. In addition to these there are beds of as yet undeterminate origin which make up a considerable part of the formation.

A review of the literature on the Saginaw formation shows that several attempts have been made to subdivide it. The last and most elaborate of the subdivisions, in which fourteen coal horizons are recognized, was made by Cooper.[39] This classification is not supported by Smith,[40] who holds that "none of the coal beds extend continuously over the whole basin and few are continuous over any considerable part of it." A critical study of some of the numerous test holes and drill records which form a great part of Cooper's Bay County report leads one to believe that the subjective element would enter into correlation carried on by means of superposition of seams. The log of test hole No. 362 [41] shows three riders between the Lower Verne Coal and Salzburg Coal, and the omission of the Upper Verne Coal, when the normal succession should be Lower Verne Coal, Lower Verne Rider, Upper Verne Coal, Upper Verne Rider, Salzburg Coal. A test hole near Wolverine Shaft No. 2 in the north part of Bay County shows two riders between the Upper Verne and Salzburg coals,[42] whereas one only is supposed to occur. Test hole No. 238 does not show the Saginaw Coal, although the Middle Rider is identified.[43] Several other examples might be cited to illustrate the fact that the logs are capable of at least two interpretations. One must believe correlations of the foregoing kind would have to be substantiated by careful analyses of not only the coals, but the rocks above and below the seams. Cooper does not give the criteria he uses in making his correlations. The elevations above sea-level cannot be used, for there is evidence in mine workings

[39] Cooper, W. F., *op. cit.*, p. 195.
[40] Smith, R. A., p. 252 of work cited in note 26.
[41] Cooper, W. F., p. 299 of work cited in note 17.
[42] *Ibid.*, 1905, pp. 175–176.
[43] *Ibid.*, p. 261.

that pronounced rolls to the individual seams are by no means uncommon. R. A. Smith [44] cites an example from the Bliss mine of Saginaw County.

Some method of subdividing the Saginaw formation must be used other than those employed in Cooper's classification. In this respect one might return to the later views of Lane [45] which emphasize the importance of the Verne horizons because they are associated with marine fossiliferous strata.

It is generally agreed that marine deposits are accumulated under more uniform conditions than terrestrial deposits, and it might be inferred from this statement that marine members would be more constant in composition and thickness than coal seams would be. Several sections of the Saginaw formation show at least two fossiliferous marine members. Together with other criteria, such as the flora, a consideration of the lithology of the overlying and underlying strata and unconformities, the marine members may prove to be critical beds in the division of the Saginaw.

Sections of the beds of the Saginaw formation that are exposed from the southern to the northern limit of the coal basin frequently show the presence of a shale member containing an abundance of brachiopoda which belong apparently to the species *Lingula carbonaria* Shumard. This is the zone which Lane [46] considered occurred above the Upper Verne Coal. A section in the vicinity of Grand Ledge, Michigan, shows two *Lingula* horizons separated by shales, sandstones and a seam of coal. A study of the Pennsylvanian faunas which is now being carried on leads the writer to believe that there are possibly more than two *Lingula* horizons. Because of their present undecided stratigraphic location and the need of future study of their faunules, the *Lingula* members will not be further treated in this paper.

Another fossiliferous marine member has been referred to by Lane [47] and Cooper.[48] Lane does not state which fossil is the most characteristic of the member, but Cooper considers *Marginifera*

[44] Smith, R. A., *op. cit.*, p. 253.
[45] Lane, A. C., p. 89 of work cited in first reference in note 21.
[46] Lane, A. C., p. 43 of the work cited in note 12.
[47] *Ibid.*, p. 43.
[48] Cooper, W. F., p. 185 of work cited in note 17.

(*Productus*) *muricata* (N. & P.) to be one of the four most commonly occurring forms. Several mine shafts in the Saginaw Valley seem to indicate that this member is present over a wide area. Outside the Saginaw Valley a fauna characterized by Productidae has been found at Grand Ledge.[49] This fauna differs in detail from those listed by Lane. Moreover, it occurs stratigraphically above beds containing *Lingula*, whereas the reverse order of occurrence applies to all other listings of *Lingula* and *Productus* in Michigan.[50] There is a possibility that more than one *Productus* horizon exists.

The literature on the Saginaw formation contains frequent references to nodular seams of black iron ore, without indicating whether these beds are extensive or very local in distribution. At the present time the rank of member cannot be applied to any of these readily recognizable beds.

Preliminary investigation of a few sandstone samples by means of elutriation indicates some notable differences in the mineral contents and the textures of different beds. Any further work along this line may serve to either group or separate the imposing array of sandstones that are mentioned in almost any section or well-log of the Saginaw. Similarly, the varying types of shales might lend themselves to a serviceable grouping.

Coal seams may be grouped on the basis of whether they are coking or non-coking, or high or low in sulphur. The coking coals of Michigan which have a high sulphur content are stated to be younger than the non-coking and low sulphur varieties.[51] This statement may require further substantiation. If this is proved true, it will be of aid in the subdivision of the Saginaw into members.

STRIKE, DIP AND THICKNESS

The beds of the Saginaw formation are essentially horizontal, all dips which have been observed being local and of an undulatory

[49] Kelly, W. A., "The Carboniferous Fauna of Grand Ledge," *Pap. Mich. Acad. Sci., Arts and Letters*, 8: 293–295. 1927.

[50] Lane, A. C., p. 43 of work cited in note 12.

[51] Lane, A. C., p. 316 of work cited in note 14.

character.. This is exemplified in several parts of the state. Lane [52] figures a section from a mine in Sebewaing and Smith [53] describes an example observed in the Bliss mine at Swan Creek, Saginaw County. Another line of evidence is furnished by a well drilled near Saginaw on a Pennsylvanian structure. No production was obtained from the beds which are petroliferous in the adjacent Saginaw field. According to R. B. Newcombe [54] of the State Geological Survey, these results do not indicate a similar pre-Pennsylvanian structure. Apparently the local structures reflect the topography of pre-Pennsylvanian time, and the upward arching was produced by the settling of the strata along the flanks of preëxisting hills.

The thickness of the Saginaw formation varies. In Arenac County it is said to be less than 100 feet.[55] The maximum thickness for this formation is more than 600 feet.[56]

PHYSIOGRAPHIC EXPRESSION

The Saginaw formation throughout the greater part of its areal extent is concealed by drift. It occupies a low, flat country surrounded by a rim of higher land that partially reflects buried escarpments. These were produced by heavy sandstones and limestones belonging to the Mississippian period, during the cycle of erosion preceding the age of glaciation. The rough and irregular preglacial topography accounts in some measure for the few outcrops and for the varying depths at which bed rock is struck in well drilling. A rock contour map of lower Michigan indicates a well-developed drainage system.

PALEONTOLOGICAL CHARACTERS AND CORRELATION

Many of the sandstones and shales contain recognizable plant remains from two or three horizons. Small collections have been made in the past and sent to David White for identification. Lists of the plants identified by him are contained in reports written

[52] Lane, A. C., p. 31 of work cited in note 12.
[53] Smith, R. A., p. 253 of work cited in note 26.
[54] Newcombe, R. B., personal communication.
[55] Gregory, W. M., p. 37 of work cited in note 23.
[56] Smith, R. A., p. 263 of work cited in note 22.

by Lane.[57] White referred the collections to an age corresponding to the upper part of the Pottsville.

Some invertebrate fossils which were collected from shale and limestone members encountered in mine shafts of the Saginaw Valley and associated with the Verne Coals were identified by G. H. Girty. The collections reveal two faunules, one represented by *Lingula* and the other characterized by several species of *Productus* and other invertebrates. Girty's lists appear in Lane's report.[58] There is a general similarity between the faunas collected from the mine shafts and those from Six-Mile Creek [59] and at Grand Ledge.[60] Girty, after a study of the Saginaw Valley collections, could see no reason for disagreeing with White's conclusions concerning the age of the Saginaw formation. He considered the fauna to have a long range and to be indicative of no particular part of the Pennsylvanian period, since there was nothing distinctive characterizing it. This statement might be used in referring to the Six-Mile Creek and Grand Ledge faunules also.

However, regardless of the value of these faunules in interregional correlation, their importance in the correlation of Michigan strata may be admitted. If there is but one horizon at which the Productidae occur, it will be an easily recognizable zone and make possible at least a twofold division of the Saginaw. It has not been proved, however, that there is but one horizon at which the Productidae occur. From analogy with Ohio, on the contrary, we have reason to expect several such horizons. Our chief dependence in correlation will then be on the sequence of beds above and below the fossiliferous horizons.

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[57] Lane, A. C., footnote on pages 43–44 of work cited in note 12; pp. 87–88 of first work cited in note 21.
[58] Lane, A. C., p. 42 of work cited in note 12.
[59] Rominger, C., p. 139 of work cited in note 6.
[60] Kelly, W. A., *op. cit.*, p. 294.

HEAVY MINERALS FROM SOME PENNSYLVANIAN SANDSTONES OF MICHIGAN

WILLIAM A. KELLY AND EDWARD L. BEUTNER

OBJECT OF INVESTIGATION

THIS paper is a preliminary report upon an investigation the object of which was to determine whether heavy minerals, if present in the Pennsylvanian sandstones, occurred in sufficient quantities to be of any value in correlation work. It was hoped also that, by means of mechanical analyses and the separation of heavy minerals, some light might be thrown upon the origin of the sandstones.

LOCATION OF SAMPLES STUDIED

Twenty-five sandstone samples were examined. They were collected from the type locality of the Parma sandstone, or lowest formation of the Pennsylvanian system in Michigan, and from other outcrops believed to be of Parma sandstone. A few samples were collected from the type locality of the Ionia sandstone, the youngest formation of the Pennsylvanian system in Michigan, or, at least, the youngest formation exclusive of the drift and alluvial deposits, in Michigan. Many samples were also collected from the Saginaw formation, which is intermediate in age between the Parma and Ionia. These came from outcrops, quarries and mine dumps in Jackson, Calhoun, Ingham, Eaton, Clinton, Shiawassee, Genesee, Saginaw and Arenac counties, Michigan.

METHOD OF PROCEDURE

A series of nine specimens which were considered to be representative of known sections of the Pennsylvanian system were examined by means of a mechanical analysis. This examination was accomplished by generally following a scheme outlined by Wanless.[1] The results obtained are represented graphically by

[1] Wanless, H. R., "Lithology of the White River Sediments," *Proc. Am. Philosoph. Soc.*, Vol. 61 (1922).

means of a triangular diagram (Fig. 12), which shows the relative proportions of sand, silt, mud and carbonate making up any sandstone.

The sand content of the samples was first examined qualitatively for its mineral content. Most of the sandstones contained some feldspar, micas and heavy minerals in addition to quartz

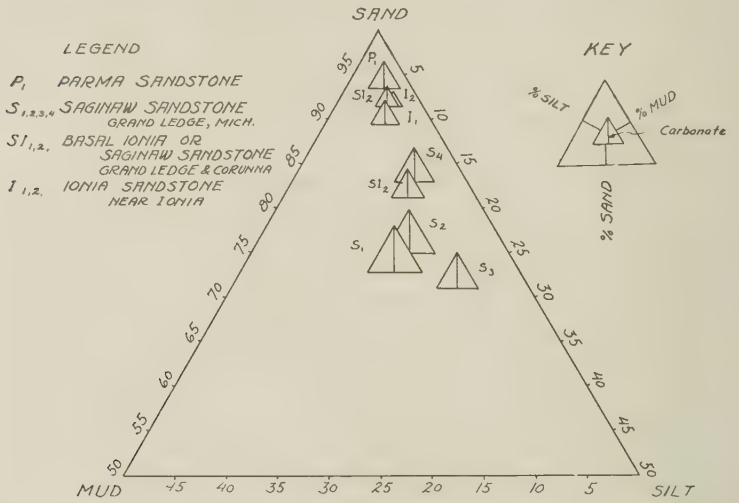

FIGURE 12

particles, but some from the horizons thought to be Parma were remarkably clean.

For a determination of heavy minerals the sand residue was treated in a separatory funnel with acetylene tetrabromide, a heavy liquid having a specific gravity of 2.97. This liquid was supplied by the Dow Chemical Company and was found to be quite satisfactory. Since available apparatus was limited, we used a very simple separatory funnel consisting of an ordinary glass funnel, to the stem of which was attached a rubber tube and pinchcock. The mineral powder and heavy liquid were thoroughly mixed, and the sands allowed to settle for twenty minutes before the heavy concentrate was drawn off. The concentrate was then

mounted in Canada balsam for microscopic study. In addition to the nine specimens already mentioned, sixteen other samples were examined for their mineral content. Heavy minerals were determined by the method already outlined.

RESULTS OF INVESTIGATION

The investigation shows that several heavy characteristic minerals are present and may be determined with comparative ease. Of these, zircon is the most common and occurs in greater or lesser quantities in nearly all the specimens examined. Tourmaline, garnet, zoisite, hornblende, muscovite, biotite, and possibly phlogopite, are other minerals which have been identified. The last three are not proportionately represented among the heavy concentrates, partly because the flaky cleavage does not permit easy settling in the heavy liquid and partly because the gravity range of the micas is between 2.8 and 3.2, and thus on either side of acetylene tetrabromide. There is a marked absence of apatite and magnetite, heavy minerals often found in sandstones.

THE PARMA SANDSTONE

This is a clean, highly siliceous sandstone ordinarily composed of 90 to 95 per cent sand grains. The hand specimen is white to light gray, friable and moderately coarse in texture. The chief mineral is quartz, and there is practically no feldspar present. Heavy minerals are not so abundant in the samples of this sandstone which were examined as in the Ionia sandstone and in the sandstone members of the Saginaw formation. Tourmaline is the most common heavy mineral determined. It is usually found in excellent crystals showing marked absorption. Zircon is much less common. Hornblende was also determined.

SANDSTONE MEMBERS OF THE SAGINAW FORMATION

These sandstones contain 70 to 75 per cent of sand, the rest being silt, mud and carbonates. The terrestrial character of some of the sandstones is shown by the presence of fossil plants and the occasional inclusion of thin coal seams. The micas, muscovite and biotite, form a large portion of the constituents of some of the

sandstones. Several heavy minerals are present. Tourmaline crystals are common in the samples examined, although not so abundant as in the Parma samples. Zircon is more common than in the Parma. Garnet is sparingly found in irregular grains; it is far less common than the first two minerals mentioned. Uvarovite, the green variety of garnet, was determined in a specimen which came from Flushing, Michigan. Zoisite was also identified in the Flushing sandstone.

IONIA SANDSTONE

Undoubted examples of this sandstone are found in abandoned quarries near the Grand River between Lyons and Ionia. Sandstone from that locality contains about 85 per cent of sand grains and is much cleaner than sandstones from the Saginaw formation. Among the heavy minerals there is an abundance of zircon, a mineral which seems to be especially characteristic of these sandstones. In one specimen the crystal outlines were not observable. Garnet is relatively rare and tourmaline is sparingly found.

CONCLUSIONS

The preliminary work has shown that heavy minerals are present in the Pennsylvanian sandstones in sufficient quantities to be determined in a small sample.

The preliminary work also shows that further investigation along this line is promising, for while the limited amount of material already examined is not sufficient to permit drawing any definite conclusions, the samples appear to indicate that:

1. Tourmaline and zircon are the common heavy minerals;
2. The ratio of tourmaline to zircon is greater in the Parma sandstone than it is in the Ionia;
3. The feldspar content of the Parma and Ionia sandstones is low, but comparatively high in the Saginaw;
4. The sandstones of the Saginaw formation have relatively high contents of silt and mud.

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THE DUNES OF THE MANISTIQUE AREA

ELLEN B. STEVENSON

THIS study of dunes was made in the Manistique section on the north shore of Lake Michigan covering the area from the city of Manistique on the west to McDonald Lake and Seul Choix Point on the east. The area between Gulliver Lake and Seul Choix Point was only briefly surveyed; the major portion of the time was spent on the western section. Several reconnoitering surveys were made at first and later two detailed topographic maps were constructed to determine the elevations of the dunes and possibly their alignment and relation to former lake levels (Map 46).

This is the first comprehensive survey of the dunes of this region, although a brief mention of those between Manistique and Brevort Lake was made by Lane [1] in 1904. Cressey [2] has studied the dunes along the Indiana shore of Lake Michigan and as a result of this he was able to correlate the dune ridges with the Glenwood, Calumet and Tolleston-Hammond (Algonquin) stages. The remaining dunes are considered as having been formed by present Lake Michigan.

The reason for selecting the Manistique area is because it is north of the hinge-line and the dunes are spread over a wider zone, and also because the dunes formed are subsequent to Lake Algonquin. This study supplements, therefore, the work done by Cressey and may be used as one of the type locations to be compared with sections studied south of the hinge.

Limestone is exposed on the shore at Seul Choix Point, Dutch John's Point, and westward at Manistique and Thompson. The

[1] Lane, A. C., *Northern Michigan Geological Survey, Ann. Rep.*, 1904–06, pp. 96–97.

[2] Cressey, G. B., *The Indiana Sand Dunes and Shore Lines of the Lake Michigan Basin*, University of Chicago Press, May, 1928.

Indian Lake and the Manistique River embayments are deep, but farther east between Dutch John's Point and Seul Choix there is a shallow, broad one. At an earlier lake stage all these embayments were cut off from Lake Michigan by bars forming Indian Lake in one depression, and Gulliver, McDonald and Clear lakes in the other; a spit in the Manistique River depression caused the Manistique River to turn westward before entering Lake Michigan.

On the present shore of Lake Michigan, a short distance back from the water's edge, the sand which comes from the offshore terrace piles up on the shore as a result of wave action and the alongshore currents, and forms a storm beach, which, after drying

Map 46. Place map of the Michigan shore from Manistique to Seul Choix Point

out, is blown landward by the wind and deposited in a low fore-dune ridge. The ridge varies from six to ten feet in height and is continuous with a somewhat uneven front and crest. The back slope, which is much more irregular than the front, is slightly steeper but does not represent the natural angle of repose of sand.

A second fore-dune ridge inland from the first is about twenty-five feet high and varies from fifty to one hundred and fifty feet from the first. Owing to "blow-outs" its crest is irregular in height and sinuous in character. The back slope of these blown dunes is steeper and approaches more nearly the angle of repose of sand.

Behind these dunes the ridges are lower and less regular and are separated by swamps. These lagoon-swamps are crossed by long, narrow, low-curving sand ridges offering a means of traversing the marshes.

Inland from these low ridges and swamps is a series of ridges, irregular in elevation and continuity, but roughly parallel to the lake shore and transverse to the wind. Some of the high spots in this area indicate a "blow" type, but there are no very conspicuous variations from the ridge type.

Landward from these high ridge-like hills is a zone of low ridges, irregular in direction, shape and relationships, and interrupted with low peaks where the sand has been blown higher. Some of these join to the northward long, sinuous side ridges of parabola dunes whose apices lie one quarter to one third of a mile to the northward and sometimes stand seventy to seventy-five feet in elevation. Some of these side ridges have hummocks which probably mark halts of the main dune area between blow-outs. Often extensive swamps occur between these high peaks.

This significant cross-section may, therefore, be definitely separated into three distinct provinces or types. The older and higher parabolic dunes lie well back from Lake Michigan and stand above the forty-foot level. The middle belt of high dunes belongs to a later lake stage and the lesser deformed dunes and dune ridges along the shore belong to the present.

There are two possibilities in regard to the formation of this complex dune topography. One is that they were formed near their present location and the second that they have migrated and thus may represent waves of sand moving to the leeward across the country. The reason for believing that they formed at the shore and migrated landward are: first, the fore-dune ridge at the shore is relatively smooth in contour; second, the dune ridges inland show deformation of both surface and continuity. The parabola dune is formed at the head of the blow-out and blow-out is the chief means of migration. Thus, the greater the height of the dunes the greater the sinuosity until the dune ridge loses its identity entirely. Further deformation of the blow-out may lead to a wind rift and longitudinal dunes which may be separated by swamps also longitudinal in character.

The dune ridges may be traced for one hundred yards into the dune area, where they become deformed by blow-outs and can no longer be traced. This would favor the ideas that dune ridges

advance irregularly by the blow-out method and, conversely, that a smooth dune ridge is indicative of formation at or near its present location.

The other possibility as to the formation of the dune ridges is that they were formed *in situ* and blown by the wind, but have never migrated enough to become detached from their source of supply, the beach. Then the lake level lowered and additional sand areas were exposed to the wind, with subsequent formation of dune ridges in front of the old ones.

The cross-sections studied this past summer (1929), maps of which are shown in figures, as well as the map indicating beaches near the city of Manistique, substantiate the theory that migration from a shore-line approximating the present one has not been a dominant factor in the formation of the big dune ridges far inland from Lake Michigan shore.

The city of Manistique is for the most part located on a wave-cut terrace which slopes gently upward from the lake. This terrace within the city limits is unbroken save for the hill on which the cemetery is located at the eastern outskirts. The foot of this hill is a well-defined shore-line which stands between forty and forty-five feet above Lake Michigan, 620–625 A.T. According to an interpolation of the elevations shown in Leverett's map [3] of the isobases of Lake Nipissing (Map 47), this has been called the Nipissing terrace.

On Manistique Point wave action was strong in the past, and is at the present time, as evidenced by the rubble beaches (Map 48), which are well exposed within the city along Cattaragus Street between Manistique and Michigan streets. There are four of these beaches; they consist, first, of a group of three moderately developed bars of coarse rubble at successively lower elevations, and, finally, a strongly developed bar of rubble at an elevation of twenty to twenty-one feet above Lake Michigan, 601–602 A.T. This bar, from the elevations of the beaches given by Hobbs [4] on the

[3] Leverett, Frank, and Taylor, Frank, *The Pleistocene of Indiana and Michigan and the History of Great Lakes, U. S. Geol. Survey, Monog. 53*, p. 461.

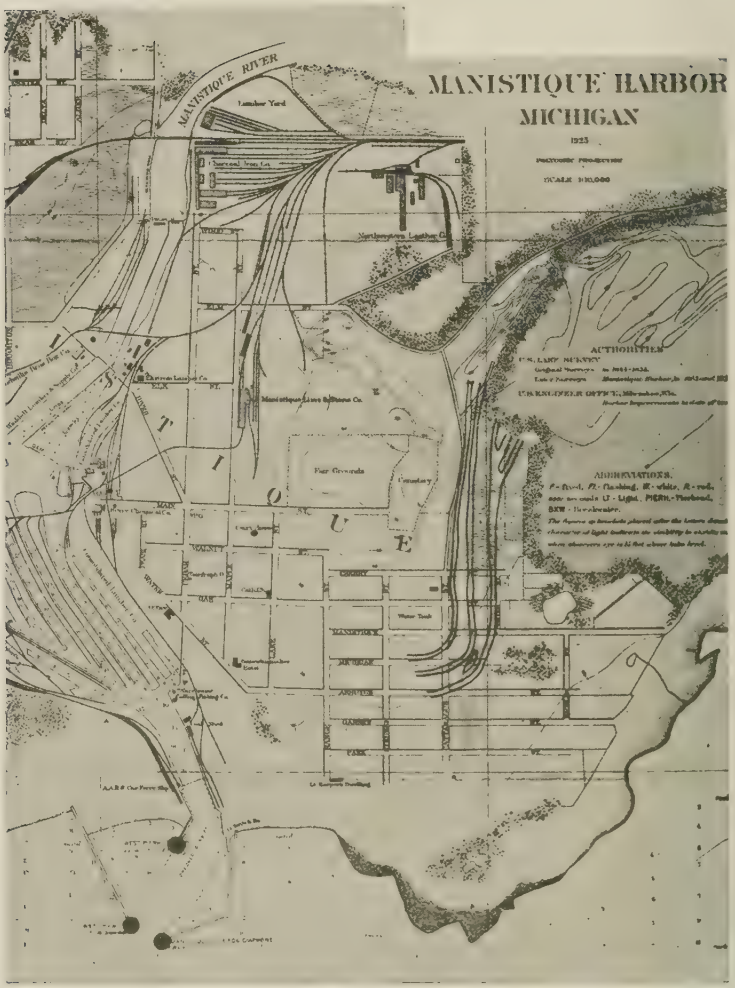
[4] Hobbs, W. H., "The Late Glacial and Post Glacial Uplift of the Michigan Basin," *Mich. Geol. and Biol. Surv.*, Publ. 5, Geol. Ser. 3, pp. 45–68.

Garden Peninsula, is considered the Algoma beach and the group of three must have been formed during the transition from Nipissing to Algoma. The significance of such bars, which is not as yet understood, will not be discussed here, inasmuch as further study of them is contemplated. These beaches turn from an east-west direction at the point and continue in a due north direction on the terrace at the foot of Cemetery Hill. At Manistique Point

Map 47. Map of isobases after Leverett

the beaches rest on bed rock and are composed of coarse rubble, which decreases in size northward along the beach and, finally, as the dune area is approached, consists of sand in the form of a bar, then a fore-dune ridge, and, in the dune area proper, blown dunes. Eastward within the dunes, the individual ridges have become deformed beyond recognition and it is impossible to correlate them with any stage.

At the opposite end of the dune area, however, approximately three miles east of Manistique, conditions are less complex, and

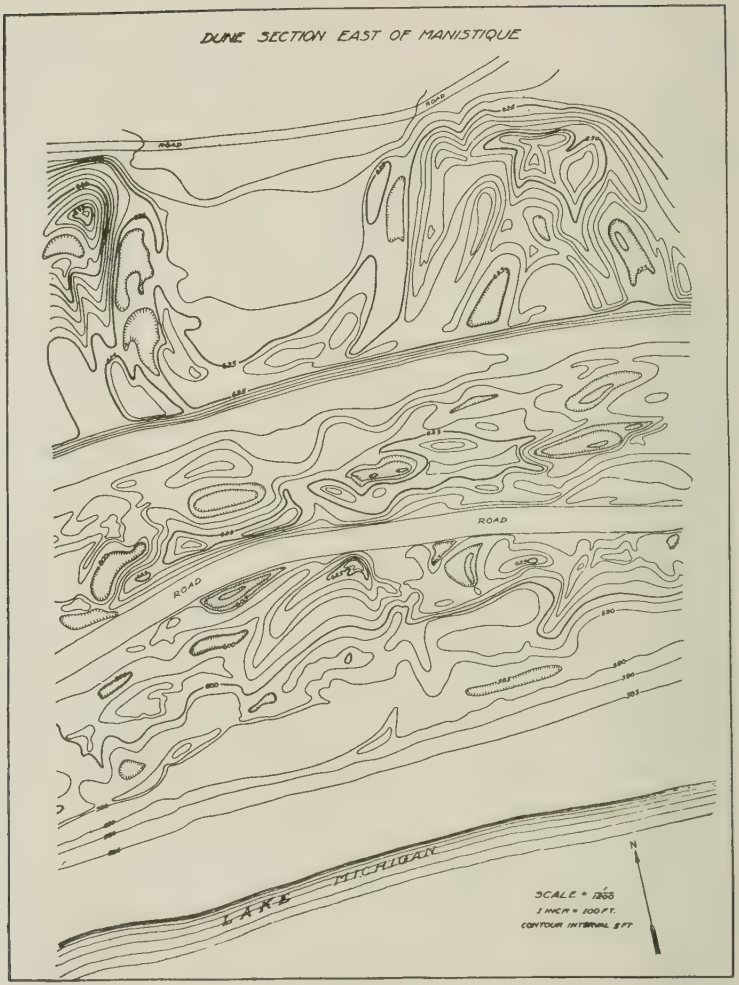

MANISTIQUE HARBOR
MICHIGAN
1923
MANISTIQUE RIVER
Lumber Yard
AUTHORITIES
ABBREVIATIONS.
Water Tank

Map 48

again the history of the dune ridges can be interpreted. An upland east of the junction of Highway 2 and the Soo Line tracks has been the locus of wave action at higher lake levels. The resulting cliff, the foot of which is twenty-one feet above the lake level, has, therefore, been cut by the waves of the Algoma stage. However, two terrace remnants at forty-five feet above the level of Lake Michigan indicate that this headland was attacked during Nipissing time also. The Nipissing shore continues west from the upland as a spit which extends nearly to the outskirts of Manistique and has turned the Manistique River westward.

On this spit a row of dunes has been piled to a height approximately one hundred feet above the present level of Lake Michigan. They consist of an almost continuous row of adjacent parabolic dunes extending from near the cliffs on the east to the outskirts of Manistique nearly two miles distant. The front slopes of these abruptly terminate at a very definite cliff of variable height (Map 49). This cliff, with its front slope representing the angle of repose of sand, is of varying elevation, but remarkably continuous, extending from the Algoma headland westward along the spit and dunes just described for about one third of a mile. The cliff forms the northern boundary of a depression which has for a southern boundary a slope lower and much more variable in contour, continuity and elevation. Just below the north wall the bed of this depression shows for most of its length a low ridge which is interpreted as a storm beach. This depression with the north wall is definitely of Algoma age, both because of its junction with the upland and because of its elevation, which is approximately twenty feet above the present level of Lake Michigan.

The zone between the Algoma cliff and the lake is occupied by a number of low, transverse dune ridges which, although linear in arrangement, are all somewhat deformed, except the almost perfectly linear low fore-dunes of the present shore. The entire dune topography from the Algoma cliff lakeward is thus opposed in topographic expression to those ridges occurring between the twenty-one- and the forty-foot levels. The former series approximately parallels the present lake shore; the series north of the cliff is nearly at right angles to it.


DUNE SECTION EAST OF MANISTIQUE
ROAD
ROAD
ROAD
ROAD
LAKE MICHIGAN
N
SCALE = 1268
1 INCH = 100 FT.
CONTOUR INTERVAL 5 FT.

Map 49

The dunes of this older series reveal almost uniformly four episodes of formation. Each of these stages seems to be a distinct wave of sand due to the deformation of the fore-dune ridges formed during a slowly sinking lake level. In this section these episodes, although they cannot be traced through, appear to correspond with the stages in the Manistique cemetery area where, as stated above, three distinct rubble beaches, in addition to the Nipissing beach, were found. The greater the deformation the greater the variation in elevation and sinuosity of the ridges. These were blown sufficiently to form large parabolic dunes upon the front slopes of which are three waves or ruffs.

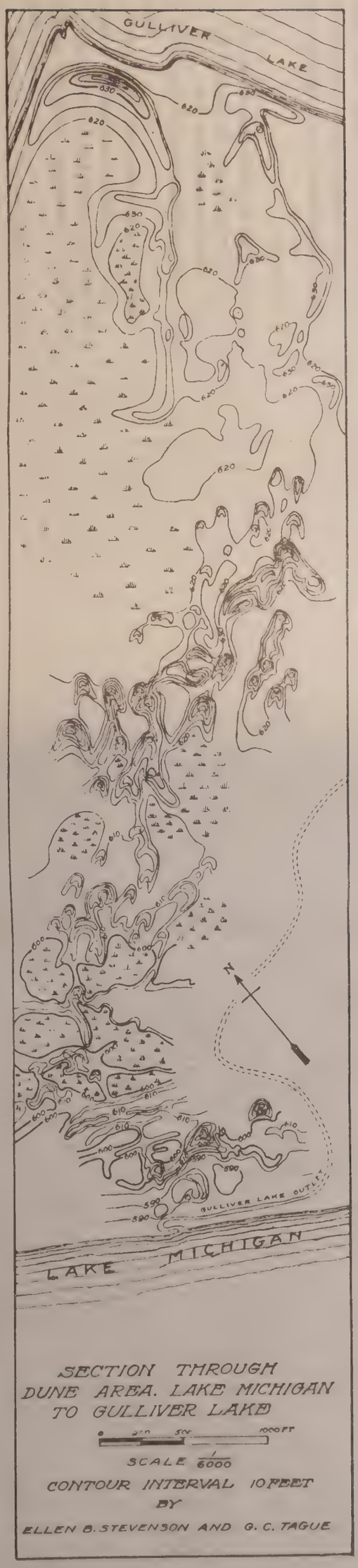
There are several breaks in this row of large Nipissing dunes. One occurs near the junction of the upland and Highway 2, and another in front of the swamp in a portion of the basin of the Manistique River just north of the highway. There are two possible explanations for the breaks; first, that dunes never formed, and, second, that they formed and were subsequently blown out and the material carried into the Manistique River. That the latter explanation is not valid in this area is evidenced by the fact that fore-dune ridges, intact, connect the upland with the row of large dunes, whereas the break farther west, as shown on the map, is bridged by an unbroken fore-dune ridge. These dune ridges were formed during the late stage of Nipissing when the lake level was dropping, owing to the down-cutting of the Port Huron outlet and uplift of the land. The termination of the Nipissing sand dunes in the Algoma cliff represents the time when the down-cutting of the outlet, the uplift, or both, were halted and erosion by the waves became dominant in this area. Since Algoma time deposition has been more important here than erosion, and has resulted in the formation of the transverse dune ridges between the Algoma cliff and the present lake.

In the Gulliver section a somewhat different condition exists. The width of the area of deposition of sand is about a mile and a half. Here three rows of high dunes occur, one along and parallel to the Michigan shore, a second intermediate zone half a mile landward and roughly parallel to the first row, and the third and highest along the shores of Gulliver Lake (Map 50).

The middle row was traced west and northward across the Soo Line tracks to the vicinity of Marblehead spur, where it drops to low, blown, fore-dune ridges of sand. Farther westward these soon change to sand beaches and then chiefly to rubbly material. The elevation of the highest and most definite of these beaches east of Marblehead spur was determined by plane table as six hundred feet, which is the elevation of the base of the Algoma cliff in the Manistique area. This has been designated, therefore, as the Algoma beach, and the intermediate row of dunes in this section was formed during Algoma time. This is in decided contrast to the cliff of the Manistique area.

The series of high dunes along the shore of Gulliver Lake, which are between seventy-five and one hundred feet in elevation, are of parabolic type and correspond in development to those of the back row in the Manistique area. These dunes decrease somewhat as they progress westward until at their crossing with the Soo Line tracks between mileposts 395 and 396 they are only forty feet in elevation. From there on westward they assume the characteristics of rather high, winding ridges of sand, blown in places and sinuous in character, until about one hundred yards from Marblehead spur they drop quite suddenly and become a series of three dune ridges. These sand bars change to definite well-defined rubble beaches, which in turn join the Nipissing cliff. Therefore this high row of dunes which has resulted from the blowing of these beaches is of Nipissing age.

The dunes formed since Algoma time are less complex and correspond in general characteristics to those of the Manistique area south of the Algoma cliff. The dunes of Nipissing age, however, are relatively complex, apparently representing large quantities of sand blown into dune ridges which subsequently became deformed. These piled one on the other, so that the three episodes, distinct in the Manistique area, cannot be identified. The high dunes with their irregular front slopes seem to have long sinuous ridges resembling arms which run southward to the intermediate row. This row of Nipissing dunes is not continuous eastward, but is broken where the sand has been blown into Gulliver Lake. This is indicated by the fact that no intact fore-dune ridges cross the gaps, as occurred in the Manistique region.


GULLIVER
LAKE
630
620
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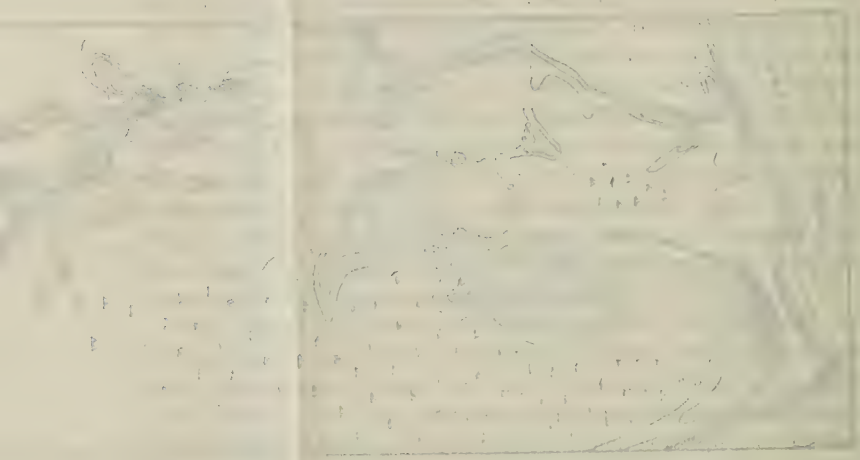
590
590
590
GULLIVER LAKE OUTLET
N
LAKE MICHIGAN
SECTION THROUGH
DUNE AREA. LAKE MICHIGAN
TO GULLIVER LAKE
0 500 1000 FT
SCALE 1/6000
CONTOUR INTERVAL 10 FEET
BY
ELLEN B. STEVENSON AND G. C. TAGUE

FIGURE 50



Southward from the high Algoma dunes, which, though blown, have not lost their ridge-like character, deformation has been decidedly less and the low fore-dune ridges do not afford evidences of having been extensively blown. They consist rather of definite ridges transverse to the shore, winding but with relatively even crests. These zones of low sand ridges between the high dunes in this Gulliver area indicate a gradually sinking lake level combined with an uplift of the land. The sand thus exposed is subsequently blown by the wind into fore-dune ridges, each dune ridge representing a more advanced position of the shore-line. When the lake level becomes consistent for a relatively long period, these are cut into by the waves and deformed into horseshoe or high parabolic dunes. A consistent lake stage is one similar to the present stage of Lake Michigan, in which only minor fluctuations of the water level occur over a relatively long time. The period of consistency was less in Algoma time than in Nipissing, as indicated by the lesser degree of deformation of the ridges.

SUMMARY

In conclusion, then, it may be said that a study of the dunes in the vicinity of Manistique has revealed for this area:

First, that this series of dune ridges spread over a broad zone is the result of a sinking lake level combined with an uplift of the land;

Secondly, that the series of undeformed fore-dune ridges indicates a continuance of these factors;

Thirdly, that deformation of these fore-dune ridges takes place during relatively stationary periods, that is, during consistent lake levels;

Fourthly, that there have been three such periods, namely, Nipissing, Algoma and the present;

Fifthly, that the Nipissing has been the greatest stage of dune formation and has been productive of the largest dunes;

Sixthly, that these results supplement the correlations of Cressey in the Indiana dune area.

University of Michigan
Ann Arbor, Michigan

A STUDY OF THE MARSHALL FORMATION IN MICHIGAN

WILLIAM A. THOMAS

THE Marshall formation was named from its numerous outcrops around the town of Marshall in Calhoun County; the upper phase of this formation has been called "Napoleon" from its typical section, which outcrops near Napoleon in Jackson County. According to Smith,[1] the Marshall should correlate with the Logan and Blackhand of Ohio and the Kinderhook of Illinois, formations which are Mississippian in age.

Glaciation and deposition have concealed the Marshall in almost all parts of Michigan, but there are good exposures in Cass River in northeastern Tuscola County, and also at Point Au Barques at the northern tip of Huron County. From these outcrops a meager amount of information about its character has been obtained. Rominger[2] merely mentions the fossils, but Winchell studied them extensively and showed that the Marshall was not correlative to the Chemung age,[3] as had been thought by Hall. This particular paper will be confined to the information we have obtained through well drilling and core testing.

In the summer of 1927 the Pure Oil Company saw the need of geological data on some shallow formation which could be used as a key horizon above the oil pay sands. Lane's description of geological structures was confirmed by intensive core testing in Huron and Tuscola counties.[4] In this paper Lane recognized faulting or

[1] R. A. Smith, *Mich. Geol. and Biol. Surv.*, Publ. 14, Geol. Ser. 11, p. 29. 1914.

[2] Rominger, C., *Geology of the Lower Peninsula, Geol. Surv. Mich.*, 3 (1873–76) : 70.

[3] *Proc. Acad. Nat. Sci. Phil.* 15 (1863); 2; 17 (1865) : 109; *Am. Journ. Sci.*, 41 (1866) : 120.

[4] Lane, A. C., *Geological Report on Huron County, Michigan, Geol. Surv. Mich.*, Vol. 7, pt. 2.

folding which had disturbed the Marshall sandstone and caused it to lie in two parallel folds, striking west, northwest and east, southeast. This old information was obtained from water wells which had been drilled in Huron County.

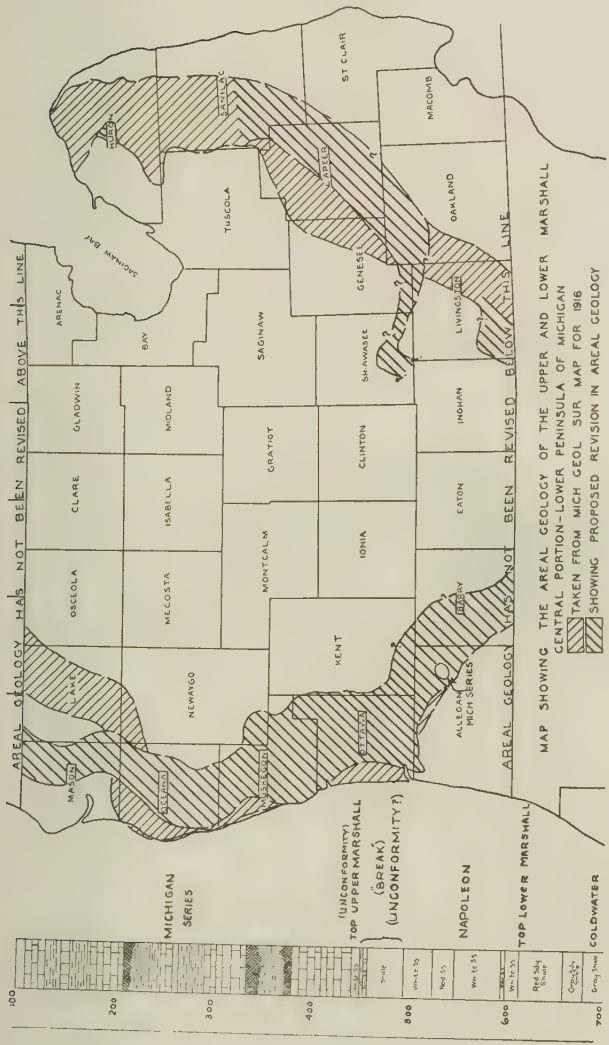
Along with the Pure Oil Company, the Dixie, the Shell, the Sun, the Muskegon Oil, the Phillips Petroleum and other concerns started coring the state by use of the hollow-rod drill, rotary and cable tools. The data which have been obtained from this program bring out some unusual and interesting stratigraphic information.

A revision in areal geology has been attempted, as illustrated on the map of the Lower Peninsula of Michigan (Map 51). The greatest change in the map is in Livingston County, where we show the Marshall to extend much farther out in the basin than previously mapped on the geological map of Michigan as compiled by R. C. Allen, R. A. Smith and L. P. Barrett in 1916. The exact boundary of the Marshall has not yet been determined in the whole area and the question marks on the map indicate the need of more detailed information. Another point that looks abnormal, but which is based on a recent test now drilling in southern Kent County, is the Upper Marshall sandstone extending into the southeastern part of Kent.

In Hopkins Township, Allegan County (T. 3 N., R. 12 E.), a recent test shows the formation immediately under the drift to be Michigan Series, so that we have attempted to show a small outlier of Michigan Series, since this is one of the few tests drilled in this general area.

Another important change in the position of the Marshall sandstone is in Mason and Oceana counties, where we show the Marshall to be nearer the rim of the basin than it has previously been mapped.

The boundary lines of the Upper Marshall are more or less arbitrarily drawn, since glaciation has left such an irregular surface floor, causing the formations to be gouged out in some places and left as outliers in others. The revision is based on data obtained through recent core testing; and when Marshall has been logged, or a good set of samples saved on deep-well cuttings, this information also has been used. Corrections of the revised boundary line



MAP SHOWING THE AREAL GEOLOGY OF THE UPPER AND LOWER MARSHALL
CENTRAL PORTION-LOWER PENINSULA OF MICHIGAN
TAKEN FROM MICH GEOL SUR MAP FOR 1916
SHOWING PROPOSED REVISION IN AREAL GEOLOGY

MAP 51

of the Marshall will undoubtedly be made in the future, but at the present time this map seems to be more accurate than the old map based on the meager information available at that time.

In the eastern part of the state the Marshall sandstone, Mississippian in age, is our first key horizon penetrated. This lies almost conformably over the Berea, Traverse and Dundee formations. The data concerning the detailed structural conditions of the Marshall are more or less confidential, but we have plotted as nearly as possible the true picture of the Marshall section from about one hundred core tests which have penetrated the entire thickness of the formation. A large proportion of these wells show conclusively that the Marshall is not so uniform a sand body as had been thought originally.

From the information obtained on a few of our core tests and deep-well logs a graph (Fig. 13) has been constructed. In places erosion has been so pronounced on the top of the Upper Marshall that it has cut into the Napoleon proper, as is shown by the absence of the upper part of the Marshall section. The Napoleon sand in local areas retains an almost uniform thickness below the "break" or unconformity, though wells drilled in Huron County prove the Napoleon sandstone to be thicker on the Kilmanagh structure than on the structure passing through the town of Pigeon.

In a typical section there is a very thin veneer of greenish shale at the contact of the Michigan Series and the Upper Marshall. This shale is usually so fine that it passes through an 80-mesh-to-an-inch screen and the drillers made note on their samples that green water was present, but they were unable to catch any of the shale. This grades into a clear yellowish-white sandstone, of which there is from 5 to 25 feet. The drill then penetrates an unconformity, or disconformity, within the Upper Marshall. This is termed the "break," and is well marked in most places, except where erosion on the top of the Upper Marshall has cut into the massive sand of the Napoleon proper.

The "break" (by which we mean an interruption in the normal sandstone deposition of the Marshall formation) consists of a green shale, a coal, or a limestone from 1 inch to 35 feet in thickness. The green shale is perhaps more characteristic and Dr. Slawson

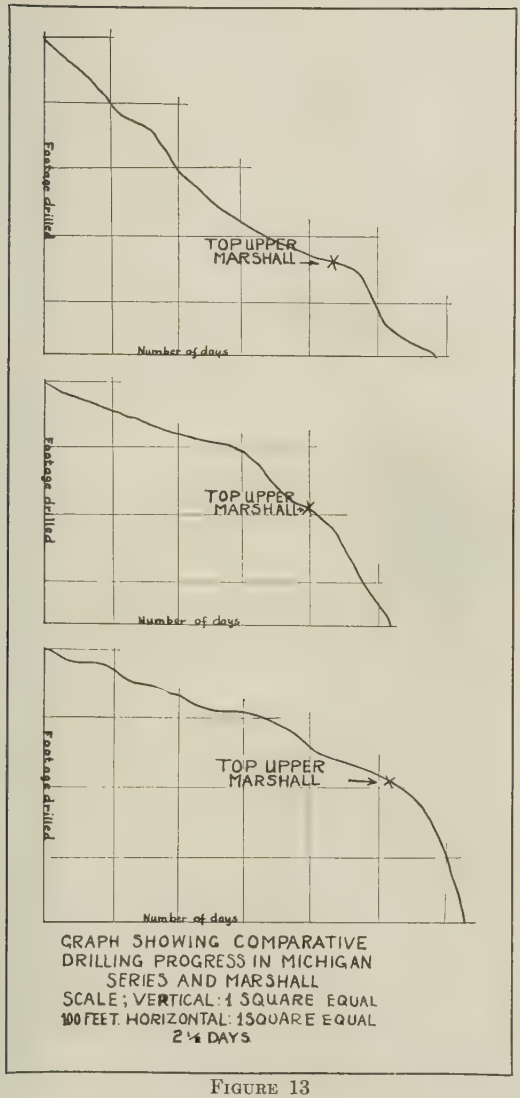

Footage drilled
TOP UPPER MARSHALL
Number of days
Footage drilled
TOP UPPER MARSHALL
Number of days
Footage drilled
TOP UPPER MARSHALL
Number of days
GRAPH SHOWING COMPARATIVE DRILLING PROGRESS IN MICHIGAN SERIES AND MARSHALL
SCALE; VERTICAL: 1 SQUARE EQUAL 100 FEET. HORIZONTAL: 1 SQUARE EQUAL 2 ½ DAYS.

FIGURE 13

examined one of these samples, giving the following description: "This sample was essentially quartz, but there were a number of globular green masses. These masses consisted of many minute crystalline scales of chloritic material. The scales are so small that it is impossible to designate any member of the chlorite group. The aggregate index of refraction is approximately 1.59, which would be characteristic of any of the chlorites. All of the material appeared to me to be derived from a sandstone because of the preponderance of quartz. There is good deal of clay present and you may have washed out still more." As suggested, shale was present in these samples and, with the chlorite, it indicates an hiatus, differing greatly from the sand above and below.

The question may now arise whether this break should not be used as the contact between the Marshall and the Michigan Series. Further examination shows, however, that the sand above it closely resembles the sand below it, and the absence of gypsum from the sandstone also helps to identify it with the Marshall group in preference to the Michigan Series. Another point in favor of correlating this sand above the break with the Marshall is the similarity of the oil found above the break to that taken from the unquestioned Marshall. Both oils have an asphaltic base and register gravity of $24\frac{1}{2}$ degrees Baumé. This oil is of such a heavy texture that it is practically impossible to pump, and its low gasoline content makes it of very little commercial importance at the present time. The oil of the Michigan Series is usually of a greenish color and lighter in texture than oil from the Marshall formation. Both oils examined were from the Midland-Isabella Oil Pool.

Below the shale, coal or limestone break, the section again becomes a white-yellowish sandstone, which grades into a peanut conglomerate near the base. Very often a band of marcasite is encountered at the top of this sand from one-half inch to two inches in thickness. The matrix binding the sandstone grains is a very soft Kaolin-like material; according to an analysis furnished by the Department of Mineralogy of the University of Michigan, this substance is gibbsite (AlO_3H_3), an aluminium hydroxide. There are from 45 to 110 feet of this sand.

The Lower Marshall contact is very definite. The sand of the Lower Marshall is a very fine gray micaceous sandstone alternating with gray shales, and red shales and sandstones. Where the red sandstones and shales are absent, the gray sand is extremely micaceous, often carrying muscovite, biotite and occasionally phlogopite in the same sample.

We have tried to describe the Marshall section in detail, as brought out by the drilling program, and we should like to suggest definite limits for the terms already in use for this formation. To date "Napoleon" has been used interchangeably with "Upper Marshall" to describe the section from the Michigan Series to the fine gray sand and red rock of the Lower Marshall. As the U. S. Geology Survey does not encourage the naming of a new formation unless it outcrops, no new name can be attempted at this time. Since we have this definite break or disconformity within the section formerly termed "Napoleon," it would seem best to limit the terms "Upper Marshall" and "Napoleon," and to give to each a specific meaning. "Upper Marshall" could be used to describe the sand from the base of the Michigan Series to the base of the shale, limestone or coal which indicates the disconformity. The name "Napoleon" would then be applied to the sand between the break and the Lower Marshall. The term "Lower Marshall" would still be used for the section from the base of the Napoleon to the blue-gray shale of the Coldwater formation. This is illustrated in the following section:

Michigan Series	Gray limestone, dolomite, calcareous shale, shale and gypsum
Upper Marshall	White to gray sandstone, gibbsite. Unconformity ("break") — green and gray shales, limestone and coal
Napoleon	Massive yellow-white sandstone, rather coarse grained, often peanut conglomerate at base, gibbsite
Lower Marshall	Fine-grained gray sandstones and shales, red sands and shales, very micaceous

Dr. Alfred C. Lane suggested the terms "Neo-Marshall," "Meso-Marshall" and "Eo-Marshall," instead of "Upper Marshall," "Napoleon" and "Lower Marshall," as used above.

In general the Marshall is thinner on structure than in the

synclines. Near the center of the Lower Peninsula it is usually thicker than around the rim of the basin. Near the rim the rate of dip is somewhat variable, but in general the beds dip 17 feet to the mile from the rim of the basin to the center, a short distance northwest of Mt. Pleasant, Isabella County.

On the western side of the state the Upper Marshall, Napoleon and Lower Marshall together attain a thickness of approximately 200 feet; in the Huron County area the thickness is between 450 feet and 500 feet. The color of the Marshall section on the western side is more red to pinkish; on the eastern side of the state the reds occur only in the Lower Marshall.

The color of the Upper Marshall suggests that the waters containing iron came from the old pre-Cambrian land mass of the Upper Peninsula. The iron material carried by the waters draining into the sea, which covered the Lower Peninsula, was precipitated in greatest quantities on the western side during the entire Marshall period. On the eastern side of the state there were alternations of the western waters and possibly the eastern waters, which contained very little iron material. This accounts for the gray shales of the Lower Marshall with only an occasional fingering of red. The distance from the source beds of the iron content may also be used to account for the depositing of lesser amounts of the heavier minerals on the eastern and southern sides of the state, when compared with the amount deposited on the western side of Michigan.

It would seem that the eastern waters free from iron sediments predominate throughout the Upper Marshall and Napoleon; in places we find no reds whatever in these formations on the southeastern side of the state. The center of the basin was evidently more influenced by the western drainage throughout the Lower Marshall period, since 80 to 90 feet of red sand and shales are common immediately below the Napoleon. During the Upper Marshall and Napoleon deposition, however, there seems to have been less iron content in the waters, since the reds are found only on the western side of the state, but the Upper Marshall and Napoleon of the center of the basin consist of a white sandstone with only an occasional streak of red sandstone.

The Marshall sandstone contains a brine from which the Dow Chemical Company of Midland has been producing for over thirty-five years. The constant drain on the Marshall water has lowered its static head, so that the wells on structure have a head of only 300 feet, but those off the axis have about 800 to 1200 feet, with an occasional flowing well. There is also a very noticeable demarcation in the sandstones in wells where the static head is low; the upper portion of the sand from which the brine has been exhausted shows considerable oxidation, though the lower 20 feet of the sand has the characteristic white of the Napoleon without any apparent change in color.

The bromine content of wells on structure is much less than that of wells drilled in the synclines, as shown by the following table:

	Percentage of bromine
Laura Root Number 1, Section 18, Greendale, Midland (T. 14 N., R. 2 W.)	0.0059
G. West Number 1, Section 25, Isabella, Isabella (T. 15 N., R. 4 W.)	0.0425
Shepherd Number 1, Section 23, Chippewa, Isabella (T. 14 N., R. 3 W.)	0.1777
Buck Number 1, Section 19, Geneva, Midland (T. 15 N., R. 2 W.)	0.1349
Isabella State Bank Number 1, Section 8, Denver, Isabella, (T. 15 N., R. 3 W.)	0.1536

The Root Number 1 and West Number 1 are on structure, the others are off.

The Marshall water is, in general, strongly saturated with chlorine compounds, and much might be accomplished from the analysis of waters throughout the state for correlation purposes were it not for the fact that the bittern seems to have a mixed source; it is usable, however, in most local areas. Undoubtedly there are fractures or faults between the Marshall and lower-lying beds which allow the waters to migrate from one formation to another.

The following is an analysis of the water from the Shepherd well (Section 23, T. 14 N., R. 3 W.) made by the Dow Chemical Company and shows a typical Marshall brine for the center of the basin.

Specific gravity	1.236
Bromine	0.1777
Calcium chloride	12.50
Magnesium chloride	2.77
Sodium chloride	10.50
Potassium chloride	0.76

The drilling through the Marshall has brought out some very interesting information which could be used by anyone planning to drill in the future. The Michigan Series contains an abundance of gypsum, limestone, dolomite and marcasite streaks which are very difficult to drill. To illustrate this, we have plotted the number of days required for drilling the Michigan Series as compared with the time it takes for drilling the Marshall formation. In doing this a record of the footage made each day was plotted on the vertical scale, the number of days drilling being represented by the horizontal scale (see Fig. 14). As the wells are drilled deeper, this curve in reality should begin to flatten out instead of becoming accentuated, or tending toward the perpendicular; the reason is that with depth more time is required for raising and lowering the tools in the hole and for replacing bits than is consumed for the same purposes when drilling near the surface.

Despite the rapidity of drilling in the Marshall, it is frequently a hazardous undertaking in fields where drillers are not accustomed to the formation. The following conditions are usually found: If the drillers' bit is not dressed out to gage, a "fishing" job often results when a new bit is run into the hole. Furthermore, the Marshall sandstone is very abrasive on the sides of the bit and at no time is it possible to run over a five-foot screw with safety unless the driller knows his bit is out to full gage. Near the base of the Napoleon the sand is so loosely cemented that the bailer is likely to become frozen. In spite of these difficulties, however, core testing in Michigan is successful on the whole, and much important information has resulted from the use of the diamond drill and the hollow rod.

In conclusion, the following summary seems to bring out the most important results of core testing in Michigan:

1. A slight unconformity or hiatus is found to be very per-

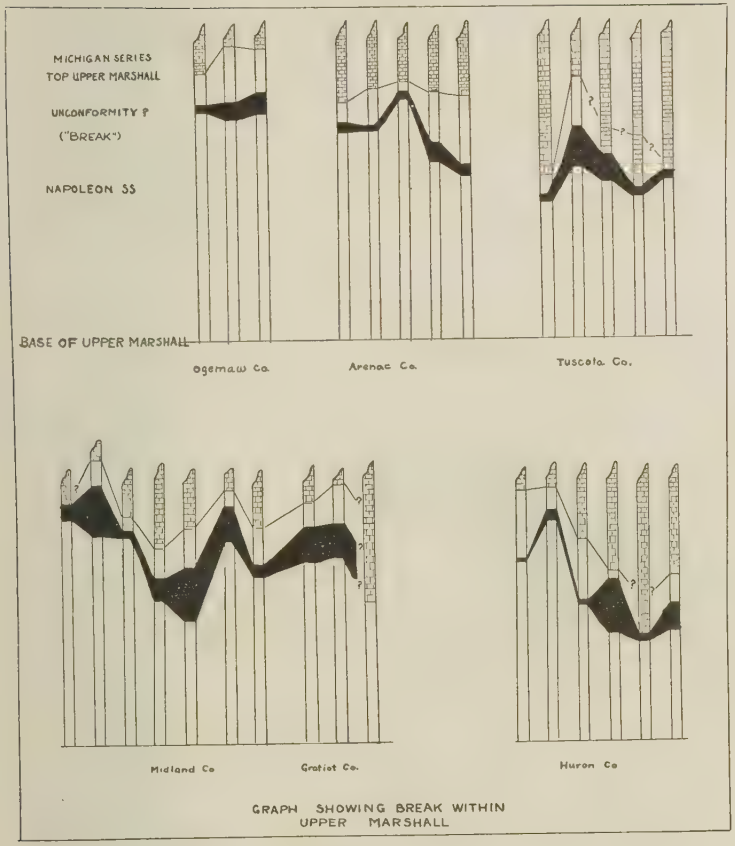


FIGURE 14

sistent in the section between the base of the Michigan Series and the Lower Marshall.

2. Because of the persistence of the break in the section formerly designated as "Upper Marshall" or "Napoleon," this section should be separated, and this paper has suggested calling "Upper Marshall" the part from the base of the break upward to

the base of the Michigan Series. The lower massive uniform sand, or the section below the break, we would call "Napoleon."

3. In some places the erosion on top of the Upper Marshall has completely cut out the Upper Marshall, the break and about 20 feet of Napoleon.

4. The Marshall on the eastern side of the state is conformable over the lower formations, but on the western side there seems to be a pronounced unconformity between the Upper Marshall and the underlying beds.

5. The source of the red color must have been from the northwest.

6. The use of brine analysis for correlation purposes is, in general, diagnostic over small areas.

Acknowledgments are here made to Mr. R. B. Newcombe for the data which he furnished for the areal map of Michigan, and to Dr. C. B. Slawson for his analysis of samples.

Pure Oil Company
Saginaw, Michigan

THE ELECTIONS OF 1862 AS A VOTE OF WANT OF CONFIDENCE IN PRESIDENT LINCOLN

WINFRED A. HARBISON

IN THE fall of 1862 President Lincoln's administrative policy and his management of the war were submitted to the voters of the North for their approval. Although there was no presidential election, the campaign for congressmen, state officers and members of state legislatures was made almost entirely upon national issues. In most of the states where a close contest was anticipated the Republicans united with the War Democrats to form a coalition ticket, usually under the name of "Union Party," and on a broad platform pledging wholehearted support to the Administration for a vigorous prosecution of the war. The regular Democratic party also professed support to the government and the war, but opposed the war policy of the Administration.

The result of the elections was unfavorable to the President. New York, New Jersey, Pennsylvania, Ohio, Indiana, Illinois and Wisconsin, all of which, except New Jersey, had cast their electoral votes for him in 1860, now declared against his Administration. The same disaffection in a presidential campaign would have resulted in a defeat, by an electoral vote of 86 to 127. This result is of even greater significance, owing to the fact that the strongly Democratic South did not participate in the election. The result, therefore, may fairly be considered as the equivalent of a vote of want of confidence in the Administration. Moreover, in the congressional elections the Democrats carried a large majority of the districts in the states mentioned, and failed to control the House of Representatives only because of the large Republican

majorities in New England, the western states and the border slave states.[1]

In most states this result was due to a substantial falling off in the Republican vote, both numerically and relatively, from that of 1860.[2] This fact was the more remarkable because the Administration party had received a considerable accession from those who had supported the Democratic or Constitutional Union tickets in the presidential campaign. Many Republicans went over to the Democratic standard and a much larger number abstained from

[1] According to the classification of *The Tribune Almanac and Political Register* for 1863 and 1864, the House of Representatives during the last session of the Thirty-seventh Congress, was composed of 103 Republicans, 44 Democrats and 30 border-state Unionists, and the newly elected body contained 102 Republicans and Unconditional Unionists, 75 Democrats and 9 border-state Unionists.

[2] The following table, compiled from *The Tribune Almanac*, reveals the extent of the Republican loss in each state:

State *	1862			1860		
	Rep. (Union)	Dem.	Majority	Rep.	Dem. and C. Union	Majority †
Maine	45,534	39,509	R. 6,025	62,811	38,107	R. 24,704
New Hampshire	32,150	30,275	R. 1,875	37,519	28,404	R. 9,115
Vermont	30,032	3,911	R. 26,121	33,808	10,836	R. 22,972
Massachusetts	80,835	52,587	R. 28,248	106,533	62,642	R. 43,891
Rhode Island	11,195	62‡	U. 11,133	12,244	7,707	R. 4,537
Connecticut	39,782	30,648	R. 9,134	43,792	33,500	R. 10,292
New York	295,897	306,648	D. 10,752	362,646	312,510	R. 50,136
New Jersey	46,710	61,307	D. 14,597	58,324	62,801	D. 4,477
Delaware	8,155	8,044	U. 111	3,815	12,224	D. 8,409
Pennsylvania	215,616	219,140	D. 3,524	268,030	208,312	R. 59,618
Ohio	178,755	184,332	D. 5,577	231,610	210,831	R. 20,779
Indiana	118,617	128,160	D. 9,543	139,033	133,110	R. 5,923
Illinois	119,761	136,060	D. 16,299	172,161	160,215	R. 11,946
Michigan	68,716	62,102	R. 6,614	88,480	65,057	R. 23,423
Wisconsin	59,041	65,227	D. 6,186	86,110	66,070	R. 20,040
Missouri	41,811	43,068	D. 1,257	17,028	148,490	D. 131,462
Iowa	66,014	50,899	R. 15,115	70,409	55,111	R. 15,298
Minnesota	15,754	11,542	R. 4,212	22,069	12,668	R. 9,401
California	51,238	37,331	R. 13,907	38,734	81,131	D. 42,387
Oregon	7,039	3,450	R. 3,589	5,270	9,140	R. 3,870

* Maryland and Kentucky held no important election.

† In most states the Republican plurality was much larger than the majority because there were three other important parties.

‡ No opposition party for governor.

voting. The causes for this disaffection and indifference were several, and varied somewhat from state to state and in different sections of the same state. There was the natural conservative reaction from the presidential election of 1860, a contest which had precipitated a great rebellion. Some of the more conservative of those who had voted for Lincoln had not realized the potential consequences of such a step and soon regretted their action.

Many Republicans claimed that the defeat of the party was mainly due to the fact that a large majority of the soldiers in the field were Republicans and War Democrats — that the Administration would have been sustained in several of the states lost if the soldiers had been permitted to vote.[3] Mr. Rhodes rejects this explanation as having little to do with the result.[4] It seems to me, however, that, had the soldiers been given the ballot, their majority for the Union party would probably have more than wiped out the Democratic majority in such closely contested and important states as New York, Pennsylvania and Ohio. The soldier vote — where it was permitted by state law and kept separate from the ordinary vote — in 1862, 1863 and 1864 averaged almost 4 to 1 in favor of sustaining the Administration, and even an approximate of such a ratio among the soldiers of the states mentioned would have reversed the popular decision.[5]

The absence of the soldier vote, however, influenced only the degree and not the causes of the Republican disaffection. The Democrats attacked the course of the Administration from various angles in an attempt to win over the wavering Republicans and War Democrats. Although the political campaign was well under way before the President promulgated his proclamation of emanci-

[3] New York *Tribune*, Oct. 13; New York *Evening Post*, Nov. 5; Chicago *Tribune*, Nov. 6; Philadelphia *Press*, Oct. 16; Cincinnati *Commercial*, Oct. 16; Blaine, James G., *Twenty Years of Congress*, 1 : 443. All dates in this and the following notes are for 1862 unless otherwise indicated.

[4] *History of the United States*, 4 : 166.

[5] The Democratic majorities were 10,752 in New York, 3,524 in Pennsylvania and 5,577 in Ohio. In 1864 the Ohio soldiers voted 41,146 to 9,757 for the Union party, and the Pennsylvania soldiers voted the same way, 26,712 to 12,349. The general ratio was about the same in 1862 as it was in 1864. It is also significant that the Democrats in such states as New York and Indiana opposed extending the suffrage to the soldiers in the field.

pation, the slavery issue was already before the people. The Democratic leaders were claiming that Lincoln had allowed the government to come under the control of the "Abolitionists," and that the object of the war had been perverted from the restoration of the Union to a struggle for the negro. Their hope was to win the support of those Republicans who did not favor an anti-slavery war. The President's proclamation intensified the contest and gave the opposition party a more definite point of attack.

It is not easy to determine the exact effect of Lincoln's new policy upon the election. Certain it is, however, that the proclamation did not meet the unanimous approval of those who were supporting the Administration. Although the vast majority of the radical element hailed it as the opening of a new and nobler era, some of this class were still not satisfied. Many fervent Republicans felt that they had waited too long; consequently, they had little enthusiasm for the belated act of justice.[6] Such influential men as Vice-President Hamlin, William Cullen Bryant and Governor Andrew of Massachusetts complained that it was not so comprehensive and positive a document as the occasion demanded.[7]

The real dissatisfaction in the party, however, came naturally from the more conservative wing. Thurlow Weed declared: "I greatly fear that the Proclamation has 'done for us.' . . . In the very broadest and strongest sense of the language, I assure you that it has strengthened the South and weakened the North." [8] Senator Dixon of Connecticut refused to fall in line with his radical constituents and support the proclamation.[9] To Senator Fessenden, the President's action seemed to be, as best, only a *brutum fulmen*.[10] There was a serious weakening of the political accord between Lincoln and Senator Browning because the latter was opposed to the new war policy. In fact, after this Browning re-

[6] Gurowski, Adam, *Diary*, 1 : 277–278, 281–282; H. Barber to Senator Trumbull, Oct. 30. — Lyman Trumbull Papers, MS., Library of Congress.

[7] Hamlin, C. E., *Life and Times of Hannibal Hamlin*, p. 443; Godwin, Parke, *Biography of William Cullen Bryant*, 2 : 190; Pearson, H. G., *Life of John A. Andrew*, 2 : 51; the *Liberator*, Sept. 26.

[8] To John Bigelow, quoted by Don Sietz, *Horace Greeley*, p. 244.

[9] Mark Howard to Secretary Welles, Sept. 24, 27. — Gideon Welles Papers, MSS., Library of Congress.

[10] *Diary of Orville Hickman Browning*, 1 : 587–588.

fused to do more than nominally support the Union party, even in his own state.[11]

With such a spirit of reluctant acquiescence and moderate criticism prevailing among the leaders, the rank and file of the conservative Republicans could not be expected to support the measure unanimously. The most extensive opposition to the new policy appeared in the border free states. Nor was the enthusiasm of the radical element in those states sufficient to counteract the conservative disaffection.[12] Senator Sherman, who was canvassing in Ohio, observed that when he expressed his approbation of the proclamation, it was met with coldness and silence.[13] H. S. Bundy, the Union candidate for Congress in the eleventh district of Ohio, which included some of the counties along the Ohio River, wrote to Chase on October 3 that the President's proclamation "will defeat me and every other Union candidate for Congress along the border." [14]

After the election the Democratic press claimed that the result showed that the people were in favor of a vigorous prosecution of the war on a conservative platform, and were opposed to the radical steps of the Confiscation Act and the Emancipation Proclamation.[15] Browning told the President that his action had been disastrous to the Republicans, that prior to it all the loyal people were united in support of the war and the Administration, but that it revived old party issues and gave the Democrats sufficient politi-

[11] *Ibid.*, pp. 582, 588–589. As was revealed by his course in the Senate, Browning was a representative of the extremely conservative Republicans. Francis P. Blair, Sr., said that Lincoln had ruined himself by his proclamations. — *Ibid.*, p. 601.

[12] On the other hand, the Chicago *Tribune* stated on November 6 that all the success that had been achieved in Illinois was due to the proclamation of emancipation and the removal of General Buell. Senator Grimes wrote to Chase on October 20 that the Republicans in Iowa made the proclamation one of the chief issues, and carried the state by bringing the radical element to the polls. — Salter, William, *Life of James W. Grimes*, p. 218. The *Missouri Democrat* (Nov. 5, 6, 7) declared that emancipation was the main issue in Missouri, and that the victory of the Emancipation party was an endorsement of the President's proclamation.

[13] Sherman, John, *Recollections of Forty Years*, 1 : 330.

[14] Salmon P. Chase Papers, MS., Library of Congress. Other letters from Ohio and adjoining states to Chase express the same sentiment. — *Ibid.*

[15] New York *Herald*, Oct. 16, 17, 18, 19, Nov. 8.

cal capital to win the election.[16] On October 18 the Cincinnati *Commercial* admitted: "It is very doubtful whether the Proclamation of Emancipation is endorsed by the people."

Along the border of the free states the fear of negro immigration as a result of a general policy of emancipation had considerable effect upon many conservative supporters of the Administration. The Democratic speakers took advantage of the prejudice of race by contending that, if the Republicans won the election, the liberated negroes from the Southern States would overrun the North and come into direct competition with free labor, to degrade and depreciate it.[17] The *Missouri Democrat* declared that the Democrats triumphed in southern Illinois on the strength of these arguments.[18] The Cincinnati *Commercial* summarized its explanation of the subject as follows: "If the question of emancipation were put to the people, opposition to the measure would be placed upon the ground that its innumerable blacks would come into industrial competition with whites, and disastrously affect all the interests of the laboring classes." [19]

Another policy of the Administration which both weakened the Republicans at the polls and brought forth frank condemnation from staunch members of the party was the course pursued in regard to arbitrary arrests and imprisonment. Under the authority of the War Department several prominent citizens were arrested in various states on charges of treasonable utterances and discouraging enlistments and imprisoned for an indefinite period without trial. Some of the outstanding cases were in such states as Illinois, Ohio and Pennsylvania, where the political contest was especially close.[20] In a proclamation issued September 24 Lincoln gave the executive sanction to the orders of the secretary of war.[21]

[16] *Diary of Orville Hickman Browning*, 1: 588–589. Browning recorded that Lincoln made no reply to these contentions.

[17] Cincinnati *Commercial*, Oct. 16, 18; *Missouri Democrat*, Nov. 25; Porter, G. H., *Ohio Politics during the Civil War Period*, pp. 143–144.

[18] Nov. 25.

[19] Oct. 16.

[20] Marshall, John A., *The American Bastile, passim;* Porter, G. H., *op. cit.* pp. 106–107, 142.

[21] *The War of the Rebellion: Official Records of the Union and Confederate Armies*, Ser. III, 2: 587–588.

Such a procedure laid the President open to the charge of violating one of the fundamental rights guaranteed by the Constitution. The obnoxiousness of this course was increased by the fact that the arrests were frequently suggested by local animosity or mistaken zeal, and were often attended by the insolence of subordinate officers.[22] The Democrats made frequent use of their opportunity to charge the Administration with the assumption of despotic and tyrannical powers, in order to win over the wavering Republicans. The Unionist speakers and editors found these allegations very difficult to answer, except on the ground of military necessity, which was not always apparent to the voters.[23]

It was not unnatural that moderate Republicans hesitated or refused to support the policy of the Administration when some of the party severely condemned it. Senator Sherman wrote to his brother explaining the loss of the elections: "No doubt the wanton and unnecessary use of the power to arrest without trial and the ill-timed proclamation contributed to the general result." [24] Browning told the President that his course in suspending the writ of *habeas corpus* in the loyal states where no insurrection existed had greatly aided the Democrats.[25] Fessenden maintained that the proclamation of the President was an exercise of despotic power which he did not possess.[26] According to the New York *Evening Post* of November 5, one of the two great lessons taught by the elections was that "the rights of peaceful and loyal citizens — the acknowledged guarantees of civil liberty — are not to be trifled with, or handled in an arbitrary manner."

[22] New York *Evening Post*, Nov. 5; New York *Times*, Nov. 20, 24, Dec. 15; Cincinnati *Commercial*, Nov. 4; Marshall, John A., *op. cit., passim;* Rhodes, J. F., *op. cit.*, 4: 165.

[23] New York *Times*, Nov. 20, declared: "In the recent canvass the Republicans forebore to take issue on that point at all, though their opponents made much of it. They contented themselves with trusting that the good sense and fidelity of the President would soon take note of the evil and apply the appropriate remedy." The Cincinnati *Commercial*, Nov. 4, admitted: "The Administration, by the course it has pursued, and we say it with unfeigned regret, has given its enemies just cause of complaint, and enabled them to work the very mischief which the assumption of power . . . was designed to prevent."

[24] Nov. 16. — *The Sherman Letters*, p. 167.

[25] *Diary of Orville Hickman Browning*, 1: 587–588. [26] *Ibid.*, 1: 588–589.

The most comprehensive and severe Republican condemnation of the course of the Administration was made by the Cincinnati *Commercial*, November 4, under the caption, "The Administration Destroying Itself." The editor declared that the people were rightly jealous of any encroachments upon their liberties. Loyal men everywhere acquiesced in the suspension of *habeas corpus* in special cases, but when martial law was declared over all the loyal states the necessity or expediency of such a step was not so apparent. The editorial continued:

> In what is this different from the proceedings of the Star Chamber? It is repugnant to all ideas of justice. It is neither just to the Government nor to the individual. . . . [The Administration] has so mismanaged and misdirected its energies, as to increase the dissatisfaction, stimulate distrust, multiply embarrassments, and weaken its hold upon the affections of the people. If the Administration of Abraham Lincoln fails, it will not be because it is Republican in its party elements — not because it is anti-slavery in its moral and political texture — not because of its emancipation policy — but because of its incapacity for public affairs, and because of its wanting in the forecast, the sagacity, and the ability to use wisely and discreetly the powers vested in it by the Constitution and laws, and such other powers as the exigencies of the times justify it in assuming. The people have looked to it with faith and hope; they have given it a hearty support; men and money, sympathy and good-will, have been lavished upon it. If it fails, then, it will be through its own acts, and history will record it as a plain case of Administrative suicide.

Other contributing factors in the Republican defeat at the polls included the lack of harmony among the different elements of the Administration party, the threat of the draft and its actual application in certain states, the fear of increased taxation and financial burdens, the corruption in regard to military contracts, and the opposition in the West to the high protective tariff policy.[27]

The most important cause, however, the one *sine qua non*, of the vote of want of confidence in the Administration, was the failure of the armies to accomplish decisive results in the field. After the Union victories during the early part of 1862, the popular expectation was that the war would soon be brought to a victorious

[27] See especially New York *Evening Post*, Nov. 5; New York *Herald*, Nov. 8; Philadelphia *Press*, Oct. 16, 17; Cincinnati *Commercial*, Oct. 16; *Reminiscences of Abraham Lincoln by Distinguished Men of His Time*, p. 274; Rhodes, J. F., *op. cit.*, 4 : 164; Brummer, S. D., *Political History of New York State during the Period of the Civil War*, pp. 250–251.

end. But the failure of the Peninsular campaign and the defeat at Bull Run convinced most of the people that little substantial progress was being made toward the suppression of the rebellion. The aggressive elements of the North, as embodied in the Republican party, impatiently demanded of the President a more vigorous and successful prosecution of the war. Although the repulse of the Confederates at Antietam brought relief and satisfaction, such a feeling was only temporary, for it was soon evident that merely to check a hostile invasion accomplished little toward crushing the Confederacy. The wave of depression and discontent again swept over the loyal people. The sacrifice of thousands of lives and the expenditure of millions of dollars with such small returns naturally weakened the popular confidence in the competency of the Administration to conduct the war with success.

The result of Antietam, moreover, caused little abatement in the Republican criticism of the policy of the President and his subordinates. The failure to prevent Lee's withdrawal from Maryland with his army intact, and the slothfulness of the Western army, which allowed the Confederates under General Bragg to invade Kentucky, threaten Louisville, and then escape without serious injury, caused a renewal of the dissatisfaction with the Administration's management of military affairs. Even Lincoln expressed his belief that he had lost somewhat the confidence of the people.[28] Letters from Republicans in all sections of the North to Secretaries Chase and Welles furnish unmistakable evidence that his dismal conclusion was more than true. The feeling among the great body of the President's political supporters was described by a conservative Republican of Connecticut to Secretary Welles, less than ten days after Antietam, as follows:

> I fully believe that in Ct. [Connecticut] the administration is daily losing influence. I hear republicans and true Union democrats say, on the part of the administration, there must be something wrong somewhere. Some begin to distrust the Pres. some Secy. Stanton, and perhaps still more Secy. Seward. Our best men are feeling mutified. . . . The people are excited that the sacrifice of so many of our fathers, sons and brothers in our vast army has been to so little purpose. . . . The people ask what do our rulers mean? Are

[28] To the Cabinet, Sept. 22. — *Diary and Correspondence of Salmon P. Chase*, p. 88.

they only deceiving us? We cannot much longer endure the suspense. They say the determination of the Pres. and his Cabinet is not steady, bold, calculated to inspire us, and we fear the worst. Some of our truest men talk in this way. There is a deep undercurrent among the people, of dissatisfaction, and it will in the course of a few months show its head and beat against the administration most angrily. . . .[29]

In the opinion of many of the radical leaders, the chief cause of continued military failure was the retention of commanding generals who did not have their hearts in the cause, and who preferred a compromise peace to the crushing of the Confederacy. The principal objections were made against McClellan, Halleck and Buell, all Democrats and all conservative on the slavery question. Lincoln was criticized severely for keeping such men in command of the main armies. The members of the Cabinet were almost unanimously opposed to the restoration of McClellan after the battle of Bull Run. When, therefore, he permitted Lee to escape from Maryland without even attempting to deal his army a crushing blow, Stanton and Chase, the radical secretaries, were thoroughly indignant that the President did not remove the slothful general.[30] Governor Andrew came to Washington, impatient at the dilatory military operations and the growing ascendency of the army in civil affairs.[31] Even judicious Fessenden condemned Lincoln's course with severity: "There was no excuse for giving him [McClellan] the command of the army after the Yorktown campaign, and the President cannot defend himself for so doing. He knew his unfitness and admitted it. If it had not been proved before, the failure to win Antietam (for he did not win it), and to

[29] G. A. Oviatt, Somers, Conn., Sept. 26. On October 3, Henry H. Elliott, New York, wrote to Welles: "The country is determined to *win* — and I think it will — we only want able and daring leaders in the Cabinet and field — and above all, we want a brave, and fearless, as well as able and prudent President — Mr. Lincoln is never up to the courage of the people." October 23, Henry M. Waite, Old Lyme, Conn., wrote to Welles: "Never before have I known such general dissatisfaction and dispondency, among our best citizens, as now exists. . . . The President must take more energetic measures in the War Department or his administration and popularity will be overthrown." Similar sentiment was expressed by J. J. Pease, Janesville, Wis., Oct. 20; Mark Howard, Hartford, Conn., Oct. 25. — Gideon Welles Papers, MSS.

[30] *Diary and Correspondence of Salmon P. Chase*, p. 91; *Diary of Gideon Welles*, 1 : 148, 162; Gorham, G. C., *Life and Public Services of Edwin M. Stanton*, 2 : 73.

[31] *Diary of Gideon Welles*, 1 : 162.

attack Lee on the day following, demonstrated either his incapacity or his treachery."[32] It is not difficult to imagine what such haters of McClellan as Chandler, Wade and Stevens said during this period.[33]

This opposition among Republicans to the retention of McClellan and other conservative generals was apparent throughout the country. "The truth is the great majority of the friends of the Government have no confidence in McClellan, Halleck or Buell," declared a Connecticut Republican, "and feel as if there would be no end of the war, so long as they are the chief military advisers of the President, and are continued in command of our armies."[34] On October 18 the New York *Tribune* complained: "We believe that very many of our officers, including some in high position, do not want the Rebellion crushed or suppressed, fearing that such suppression would redound to the detriment of slavery or of their party. . . . We believe that this class have had far too much influence in our military councils hitherto."

With such dissatisfaction among the Republicans in regard to the conduct of the war, it was only natural that they should lack the enthusiasm to give the Administration a hearty endorsement at the polls. The Maine elections in September — before the appearance of the Emancipation Proclamation — indicated, by the large decrease in the Republican majority, that the President's political followers were seriously discontented with the failure of the Union armies. As no substantial military success followed, there was no material improvement in the Republican vote in the October and November elections. The Democrats made their greatest political capital out of the apparent inability of the Ad-

[32] To John Murray Forbes, Nov. 13. — *Letters and Recollections of John Murray Forbes*, 1: 336–337.

[33] September 10, after the Bull Run episode, Chandler had written to Trumbull: "Your President is unstable as water, if he has as I suspect been bullied by those traitor Generals, how long will it be before he will by them be set aside & a military dictator set up. . . . For God and the country's sake, send someone to stay with the President who will control and hold him." — Harris, W. C., *Public Life of Zackariah Chandler, 1851–1875*, p. 61. Adam Gurowski, in his *Diary* (1: 274–315, *passim*), repeatedly denounced Lincoln's retention of McClellan.

[34] Henry M. Waite, Old Lyme, Conn., to Secretary Welles, Oct. 23. — Gideon Welles Papers, MS.

ministration to manage the war with success. The Chicago *Tribune* explained the situation in the West as follows: "The most powerful argument the supporters of the President had to meet was the charge, vociferated on every stump, and paraded in every Democratic newspaper, that the Administration was incompetent to carry on a war." [35]

The New York *Tribune* estimated, November 6, that 20,000 Republicans in that state voted for the Democratic candidate because they were "sick and discouraged at the mismanagement and inefficiency, through imbecility or treachery, of the conduct of the war." According to the Cincinnati *Commercial*, "the Democratic vote has been swelled by the prevalence of a notion that a political defeat would spur the Government to make war in better shape and in a more business-like manner." [36] The New York *Times* maintained that the vote in the states where the Republicans were defeated indicated a profound dissatisfaction with the method of the Administration in carrying on the war and a peremptory demand for the adoption of one better adapted to the awful emergencies of the case.[37] After mentioning some of the minor causes of the Republican defeat, the New York *Evening Post* declared:

> But these influences all together were as nothing to the depression, amounting almost to despair, which the inactive and expectant policy of the administration has produced in the hearts of the warmest and sincerest supporters of the war. The whole nation, after its gigantic preparations and sacrifices, has looked for adequate returns and looked in vain. The repeated disappointments were more than the people could well endure.[38]

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[35] Nov. 6. See also Washington dispatch in New York *Times* of November 7.

[36] Oct. 16. On November 5, the New York *Evening Post* explained that the Democrats' "most powerful assistant has been the discouragement and apathy diffused everywhere by our military failure. . . . Let the authorities at Washington be rebuked significantly, it is said on all sides, and they will do better for the future." Senator King, in a letter on November 7 to John Bigelow explaining the result of the elections, declared, "many have looked to the democrats for more vigor and energy in pushing the war." — Bigelow, John, *Retrospections of an Active Life*, 1 : 570.

[37] Nov. 5; also Nov. 6, 7.

[38] Nov. 5. Similar opinion was voiced by Thaddeus Stevens to Simon Stevens, October, 17. — Thaddeus Stevens Papers, MS.; Mark Howard,

When the prominent Republicans throughout the North thus perceived the disastrous political effects of military failure, they proceeded at once to condemn the President in severe tones, and to demand a radical change of executive policy and personnel. Leading politicians and editors, as though they were especially commissioned by the Northern people, dictated a new course for Lincoln to pursue. This tendency was particularly strong among the radical faction, but extended to some of the conservatives as well. Many boldly denounced the President for showing so much deference to Democrats in selecting civil and military officers. "Fear of offending the Democracy has been at the bottom of all our disasters," wrote Senator Fessenden. "I am not clear that the result of the elections is not fortunate for the country, for it has taught the President that he has nothing to look for in that quarter, a fact which any sensible man might have seen." [39] Three days after the Pennsylvania elections some of the Republican candidates for Congress, in an interview with Lincoln, ascribed the political defeat in their state to his retention of McClellan in chief command after the general had proved himself unwilling or incompetent to conduct an aggressive campaign. J. K. Moorhead told Lincoln that some of the most influential and earnest Republicans in the state were so indignant that, at a meeting at Harrisburg, they approved the suggestion of one of their number when he said that he would be glad to hear some morning that the President had been found hanging from a lamp post at the door of the White House.[40]

Many other Republican leaders censured the President in person or by letters. One of the most noted of these correspondents, and one whom Lincoln chose to answer, was Carl Schurz, a brigadier-general in the Army of the Potomac. A fervent Republi-

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Hartford, Conn., to Secretary Welles, October 25. — Gideon Welles Papers, MS.; John Gray, Boston, to Senator Fessenden, January, 1863. — William Pitt Fessenden Papers, MS., Library of Congress.

[39] To John Murray Forbes, Nov. 13. — *Letters and Recollections of John Murray Forbes*, 1 : 336.

[40] *Reminiscences of Abraham Lincoln by Distinguished Men of His Time*, pp. 272–276, an account by William D. Kelly, who was one of the men present at the interview.

can, he was in the habit of writing candidly to the President. He expressed the sentiment of many prominent Republicans [41] when, on November 8, he wrote from his headquarters in Virginia:

> The defeat of the Administration is the Administration's own fault. It admitted its professed opponents to its counsels. It placed the Army, now a great power in this Republic, into the hands of its enemies. . . . Is it surprising that the opponents of the Administration should have got into their hands the government of the principal States after they have had for so long a time the principal management of the war, the great business of the National Government? Great sacrifice and enormous efforts had been made and they had been rewarded only by small results. The people felt the necessity of a change. Many of your friends had no longer any heart for the Administration as soon as they felt justified in believing that the Administration had no heart for them. . . . A change was sought in the wrong direction. This was the true cause of the defeat of your Government. . . . There is but one way in which you can sustain your Administration, and that is by success; and there is but one thing which will command success, and that is *energy*. . . .[42]

The attacks of Republican journals upon the President were in some respects even more severe. Such influential radical organs as the New York *Evening Post*, New York *Commercial Advertiser* and Chicago *Tribune*, boldly denounced the "incompetency and do-nothing policy" of the military authorities, including the President, and declared that what the people demanded above everything else was action.[43] The conservative New York *Times*, generally one of the staunchest supporters of the Administration, was even more comprehensive and personal in its opposition, and for several days after the election contained at least one editorial censuring the President and his policy. On November 7, under the caption, "The Vote of Want of Confidence," the editor declared:

> There is no disguising it; — it is just that, pure and simple, whatever the spirit of the leaders. . . . The Cabinet, doubtless, might be better con-

[41] Soon after this letter was written Lincoln told Schurz that criticisms were coming down upon him from all sides, and that the letter was a terse summary of all the censure. — *Reminiscences of Carl Schurz*, 2 : 396. See also Nicolay and Hay, *Abraham Lincoln, A History*, 7 : 363; Gurowski, Adam, *Diary*, 1 : 312.

[42] *Speeches, Correspondence and Political Papers of Carl Schurz* 1 : 209–211. After this letter Lincoln and Schurz carried on an animated, but friendly debate, at first through correspondence and later through a personal interview, over the justice of the latter's accusations. See *ibid.*, 1 : 211–221; *Reminiscences of Carl Schurz*, 2 : 392–396.

[43] See especially the *Evening Post*, Nov. 5; *Tribune*, Nov. 6, 7, 8, 10.

stituted; but no such change, in itself, would inspire confidence . . . in what other way is it possible for this vote of the people to gain its object than through a change in the *spirit and purpose* of President Lincoln himself? He alone has the remedy, and he is bound by the most solemn obligations that can rest upon a popular ruler, to apply it. Whether he changes his men or not he must change his policy. . . .

The very qualities which have made Abraham Lincoln so well liked in private life — his trusted disposition, his kindheartedness, his concern for fair play, his placidity of temper — in a manner unfit him for the stern requirements of deadly war. Quick, sharp, summary dealings don't suit him at all. He is all the while haunted with the fear of doing some injustice, and in every case to accept explanations. The very first necessity of war is extreme rigor, and yet every impulse of our constitutional Commander-in-Chief has been to get rid of it. His moral earnestness no man doubts. There is not a purer patriot in the land. And yet there is something beyond this which we miss — the high sacred vehemence, inspired by the consciousness of infinite interests at stake, and infinite responsibilities. . . . Yet, it is useless to talk of this, for nature has denied to his temperament all such susceptibility. But it *is* within his power to brace up his will; for if there is anything in a man over which he has control, it is his will. It is just this which the people have demanded of Mr. Lincoln, and he is bound to do it, go against the grain though it may. We must have a fixed, steadfast, immovable determination that henceforth *all men and all things shall bend to the one sole object of making the speediest conquest of this rebellion.* That determination is certainly within the power of Abraham Lincoln. The people have demanded it, and it is his business to acquire it and maintain it.[44]

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[44] See also editorials on Nov. 5, 6, 9, 10, 11, 13. In fairness to Lincoln it must be noted that most of the conservative papers continued their faith in his Administration, and even the *Times* admitted: "President Lincoln, notwithstanding the want of confidence just declared, has still but to will it to be master of the situation."

AGAIN THE CABINET

MARY L. HINSDALE

THE late Viscount Bryce never rejected from among his chapters on the American presidency the one that is entitled, *Why Great Men are not Chosen.* And this notwithstanding the fact that it was during the incumbency of Roosevelt that he presided over the British embassy at Washington, and that he revised *The American Commonwealth* after the succession of Taft. The great publicist had the forward look. When, in 1920, the American nation vindicated the judgment of its distinguished critic, the still remembered slogan of the "best minds" was often supplemented by the promise, "He will surround himself with an able Cabinet." And, as the November election drew near, *The Literary Digest* featured a Cabinet straw that was so conspicuous and carried such convincing names that it must have obscured from a large number of voters the real nature of their executive. It was the year when the national enfranchisement of women multiplied the millions that ordinarily cast their first presidential vote as newly naturalized or just come of age. This diversion of attention from the chief magistrate to his subordinates as a campaign measure was a distinct contribution to an engaging aspect of American administrations, viz., the way that the body of official advisers to the president has been connected up, at different stages in American politics, with the mode of president-making, and has incidentally felt the cuts of that great party lash, the patronage.

Claude G. Bowers, who, whether as party keynoter or writer of period history, is a refreshing breeze, has "shown up" the Federalists as an Anglomaniac aristocracy and has borne witness for the Jeffersonians as a democracy true to the leveling influences of the wilderness. Be it noted, however, that the period of the early Republican presidents is precisely the one that gave to

American politics a fixed succession to the presidency and a semblance of a ministerial class. There were three distinct instances in unbroken sequence of the succession of the secretary of state to the presidency. Madison followed Jefferson; Monroe followed Madison; John Quincy Adams followed Monroe. Josiah Quincy, as he poured out, from the floor of the House of Representatives, a New Englander's wrath at embargo and war, had crystallized the ministerial situation into the aphorism of a government for twelve whole years by three Virginians and a foreigner. Political consciousness, if not popular consciousness, of the State Department as a stepping-stone had arrived at such a point, when Monroe assembled his administration, that he was constrained to look away from Virginia to Massachusetts, and establish John Quincy Adams in the succession. During the early Republican period long tenures of Cabinet office were common, if not indeed customary. Presidents retained the services of their former fellows in administration. To roll up examples could not restore the life of interest to forgotten names; but Albert Gallatin's long secretaryship is kept fresh and green as a standard of comparison for the prolonged tenure of Andrew Mellon.

The philosophy of the frontier upon which General Jackson established the national government gave no quarter to such principles as secretarial succession and prolonged incumbency. It was not as a training school that the Cabinet appeared to him. With his statesmanship of the camp, he was not impressed with the need of administrative training for his orderlies. He saw it as a battle ground; and he declared that his administration should not be such for the one that came after it. Not only did he proclaim the end of what he called "secretary dynasty," but he maneuvered the retirement of Martin Van Buren from the State Department when the whirligig of politics landed that secretary in an earlier heir-presumptive's place.

Sir Frederick Whyte, on his first visit to the United States, 1920, said to an interviewer that the time is not yet come when the best talent of this nation goes into politics as a profession. A study of Administration and Congressional personnel pro-

vokes the question whether it has not come and gone, whether that happy situation was not with us in our first years, when Sir Frederick's government was descending to a Perceval, a Liverpool, and a Goderich; and whether we did not put in the place of statesmen-presidents men who had the more popular record of vanquishing Indians and Mexicans, or no record at all, while England was arriving at premiers of Victorian caliber.

Spectacular men and men without a past when put into the presidency did not make an end of men experienced in government for the Cabinet. And leaders of the Senate, during that ante-bellum generation of giants there, on occasion quitted the posts where they were fighting the battles of legislation to hold portfolios at the pleasure of very inferior masters. Henry Clay was an outstanding exception to this. Clay never held Cabinet office again after the dethronement of John Quincy Adams imposed upon the party of their nurturing twelve years of waiting for return to power. On occasion, when the Whigs succeeded in electing a General Harrison or a General Taylor, and the death of each in office brought along with an accidental president a Cabinet of different factional cast from that of the departed chief, the great Whig leader rather regarded the president's council table as a good place for shelving his formidable rival Daniel Webster. The latter achieved his brilliant career in foreign affairs, holding by precarious retention under John Tyler, and called back for a second service by Millard Fillmore's reconstruction of the Zachary Taylor Administration.

This was a time when political parties alternated in power as frequently as the rigidly fixed presidential term allows. It was brief; moreover, it was the only situation of the sort in our history except a recurrence, still briefer, when Grover Cleveland's double term of democracy was divided into two by a Republican interlude. There would seem to have been less sense of a hazard of being retired to private life by going into the Administration than has belonged to later times, with the contest for the Senate grown wider and the requisite of large wealth imposed upon incumbents of first-class diplomatic posts. Return of men to the Cabinet along with the party to power is illustrated in the dis-

tinguished figure of William Marcy, who was Secretary of War to James K. Polk, and Secretary of State to Franklin Pierce. The second Harrison reinstalled the two leading secretaries of Garfield's councils, James G. Blaine in the State Department and William Windom in the Treasury. President Buchanan called back a Cabinet veteran of the Jackson era, Michigan's Lewis Cass. In the meantime, General Cass' worth as ministerial stuff had advanced very many points in his run for the presidency on a platform shifted to the new issues. Secretarial return was far from being frequent enough to constitute any such situation as Walter Bagehot wrote of, when he said it was not so much the duty of the newly designated premier to decide whom to call into the Cabinet as to distribute the portfolios. It is worthy of note, however, that the draft of a new Administration upon the Senate and the House of Representatives was so heavy as to preserve something more of an official class idea about the executive than has belonged to the latest generation of national politics. Cleveland did not repeat his first Administration in his second. Furthermore, he was the president that reduced the ministerial class doctrine from a shadow to a phantom by firmly establishing the business-man type of secretary. Daniel Manning and William C. Whitney were the initial cases, both gentlemen from New York, as was the president also.

In these appointments and others, Cleveland made an end of the unyielding Cabinet geography to which the spoils' system and the rotation principle had subjected the highest councils. The injury that excess of geography has wrought in American government is most apparent in the not too heavy caliber of the House of Representatives. A Congressional district in Ohio refuses to take over as its candidate James A. Garfield, already distinguished as chairman-of-committee, but facing a sharp contest in the district of his residence. And Champ Clark, after arriving at the eminence of Speaker of the House, is lost to its membership, because marked men cannot matter so much to American voters as their own men. So small a body as the Cabinet, chosen from among all the states, was not necessarily enfeebled by the regulations that would exclude one man, be-

cause another had been included who lived in the same state or even in the same region. Surely the rule would have raised havoc in that early era, when the Administration was made up of country gentlemen gone into politics, as it would at the present time, when the two leading secretarial types are the great lawyer and the man of large business affairs. New York City has become as much of a Cabinet recruiting ground as were ever the plantations of Old Virginia.

The rule that two Cabinet officers must not be chosen from the same state, that a Cabinet officer must not be chosen from the president's state, that a Cabinet office and a first-class diplomatic post must not be filled from the same state, has its chief interest in the testimony it bears to the invasion of great politics by petty politics. So recent a public man as Franklin K. Lane, Secretary of the Interior to President Wilson, wrote in his journal that a statesman needs to be nine tenths politician. And our sympathetic foreign critic, James Bryce, uttered in his swan song, *Modern Democracies*, that the profession of politics in the narrow sense has a larger army of enlisted persons in the United States than in all the world besides. The bending of the highest councils to the rules of the politician's game, coinciding, as it does, with the longer periods of small men for presidents, is glaring proof of an attitude toward official position that is more American than fortunate.

Within all the trammels of the spoilsman's rules, Lincoln assembled an Administration that stands out as a galaxy of statesmen. Out of his hard nomination contest he devised an Administration of a new type, taking four of his competitors for four of his seven aides in facing the impending crisis. The roster runs Seward of New York, Chase of Ohio, Cameron of Pennsylvania and Bates of Missouri. Geography remains as before when the solid figure of Stanton comes into the picture in Cameron's place. This relation of the Cabinet to president-making, or of the presidency to Cabinet-making, is a political device, but such in the better sense. When Roosevelt was constrained by Mrs. Bellamy Storer to explain his inability to prefer Mr. Bellamy Storer over the McKinley appointees whom he was re-

taining, in the correspondence that ensued he spoke of Elihu Root, then Secretary of War, as a very strong man before the people; and evidenced an effective campaign speech of the year before. The Cabinet of presidential candidates is an earnest of strength before the people. Lincoln's master personality made it a means of harmonizing factions up to a point of reasonable coöperation. President Garfield built his Cabinet on the all-the-factions plan; but the arrangement had not induced harmony when the Administration came to its early and sudden end. The application of the rival candidate principle to the State Department is a commonplace. Cleveland, with all of his innovations, observed this practice by putting the dignified Thomas F. Bayard in the ranking position of his official household. The outstanding case, measured by the attendant incongruity, of which unpublished diaries and memoirs have something yet to reveal, is that of Wilson, seating at his right hand for a season his party's leader and veteran candidate, William Jennings Bryan.

The latest chapters of Administration history show a series of great presidents and a series of small presidents. Each of these interludes has contributed its instance of a Cabinet secretary becoming president, but both elevations have more of the husk than the kernel of the old secretarial succession about them. Roosevelt doubtless had an idea of perpetuating his policies when as a president who was also party leader he virtually nominated Taft, on whom, as Secretary of War, during the interval of establishing the dependencies and building the Panama Canal, he had relied as much as he did upon his Secretary of State, Elihu Root, who was less eligible to a presidential race. Mr. Hoover's membership in the Cabinet, of more than average duration, was far outmatched as a vote-getting force by the favor he had won with the housewives of the nation as food administrator. He was a people's candidate before he was Secretary of Commerce. Only it was the party maneuverer's and not the people's year in 1920.

The latest period of great presidents has less in it of the political exploitation of the Cabinet than the ensuing season of small

presidents shows. It holds out a temptation to go into those composites of personality that determine what we might call "Administration types." The Roosevelt-Wilson contrast challenges attention. The Roosevelt régime is a striking illustration of a strong president and a distinguished Cabinet. President and secretary of state could each receive the Nobel Peace Prize for constructive work in the field of international relations. The Wilson Administration, as it seemed, when it made its inaugural bow, was represented by the pencil of the late John McCutcheon in triumphal procession, where two cars carried the Cabinet, the first one the known members, the second, the unknown, Bryan occupying the first car in spacious ease and nine indefinite gentlemen crowded together in the second one. A college president was among the unknowns. Historians will class this Administration, on the basis of its domination by its chief, as being of the Jackson type.

During the long interval from Van Buren to Lincoln and from Lincoln again to Cleveland, the upper secretaries quite generally had much higher claims to statesmanship than their masters. I have not discovered that the Cabinet which a presidential candidate could form, if he would, ever was flaunted as a qualification for the seat of ultimate responsibility. No such feature survives in the story of popular enthusiasm for the log cabin and the mustang colt. So far as the popular electorate has been concerned, Cabinet slates have waited upon the election. The holding out to the people of the president-in-council idea seems to have been peculiar to the political slump that followed close on the heels of the World War.

That the headship of the Government should be strewn about the Cabinet table was not in the minds of the coterie that arranged the Harding nomination. They were a ring of Senators that would would make themselves the power behind the throne. The "able Cabinet" slogan came following after an instalment of syndicated newspaper material, that was published in the immediate wake of the Convention, and declared that the chosen candidate was of presidential caliber, thereby provoking the question why such a declaration was called for. The pledge that

there would be much consultation with "best minds" in general and with an "able Cabinet" in particular was utilized to appeal to the masses, to whom one-man government is anathema. And the Wilson régime had been abundantly characterized as an autocracy. The implied doctrine that an able Cabinet suffices for a worthy Administration, regardless of the chief thereof, was addressed to that element in the electorate that demands something more constructive than disparagement of the existing order. The letter of the Thirty-one, published October 14, 1920, and memorable for its promise that if the Opposition were voted back into power it would fulfill the foreign policy of the retiring president, did not by declaration take a stand upon the Cabinet-for-president idea. However, one of the eleven college presidents who were numbered with the Thirty-one once said to me in the pleasant side-talk that attaches to a summer institute of politics: "We did get something done; we got Hughes and Hoover into the Cabinet: it hadn't been arranged that way before."

A few bold strokes, if skilfully done, could make a vivid picture of the type of Administration that actually was set up to meet the after-problems of the World War. There was a Cabinet with a dignified wing and an undignified wing, sharply distinguished from each other, the Department of State and the Treasury in very able hands. The senatorial ring was decimated by the death of the gentleman from Pennsylvania. The gentleman from Massachusetts, as chairman of the Foreign Affairs Committee, remained to contest with the Secretary of State for the control of the president. What unpublished documents have to tell of contrary forces pulling about the Washington Conference on the Limitation of Naval Armament one or two persons with inside information have mildly hinted. Apparently, the Secretary triumphed. Did he program some additional policy that has not yet been told? The undignified wing of the Cabinet was lopped off under weight of its own corruption. The only parallel to the situation that can be discovered in our history is a line drawn across the presidency of General Grant, master in warfare and novice in statesmanship. The

middle distance and farther end of the Cabinet table then became blurred into a good deal of indefiniteness save for the place that the Secretary of Commerce occupied. To the State Department so much distinction attached that, when in 1924 the great party battle was on again, after Vice-President Coolidge had succeeded to the presidency on Mr. Harding's death, such a fine type of citizen as the social philosopher John Spargo announced that he should vote for a new term of office to Mr. Coolidge, in order to have Secretary Hughes remain at the Foreign Affairs. Mr. Coolidge was elected president, but the Secretary of State retired.

The consideration of the American Cabinet from this rather whimsical viewpoint, coming at the end of the first decade of world reconstruction after the Great War, leaves uppermost in the thoughts a problem that is very grave, one that had a prototype for the generation that sidestepped the issue of human slavery. We would state the problem in words like these: What must be the consequence in any critical period of so distorting the Executive as to look to one place for power, while authority resides in another place?

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Bibliographical Note: — The facts used in this paper that are of earlier date than 1910 were assembled from all available sources in a general study of *The President's Cabinet* by the present author, which was published by the University of Michigan in 1911.

Facts of later date have been derived chiefly from the Washington correspondents to the great newspapers of the country, and can be verified by consulting the files of the time of the event. The more authoritative magazines that publish articles on political topics have also been drawn upon. The sources of this character are *The New York Times; The Chicago Tribune; The Christian Science Monitor; The New York Times Magazine; The Outlook; The Independent; The Literary Digest.*

CASE IN SOME EARLY AND LATER ENGLISH GRAMMARS

HOWARD G. BAKER

IN 1580, six years after Lily's Latin grammar had at last taken definitive form and been issued under the title of *A Short Introduction of Grammar*,[1] a London publisher brought out the oldest known grammar of the English language, *Le Maistre d'escole anglois*,[2] written by a Frenchman, Jacques Bellot, in French and English; but as this was mainly a conversation manual, intended for Frenchmen and other foreigners who desired to acquaint themselves with the English tongue, and was in no sense a systematic work, the history of English grammar writing more properly begins in 1586 with W. Bullokar's *Bref Grammar for English*.

Although Bullokar did not write for foreigners (the twofold aim of his book was "the speedy parsing of English speech, and the easier coming to the knowledge of grammar for other languages"), most of his immediate successors did so, a fact that explains why so many English grammars of the sixteenth and seventeenth centuries are in Latin or French, instead of the vernacular.[3] But whether the early grammars sought to instruct the foreigner, or to prepare the way for Latin, or to record the facts of the language for their own sake, the authors had in Latin grammar an apparatus ready-made, one in which they had been

[1] The first stage of "Lily's Grammar" was Dean Colet's *Absolutissimus de octo orationis partium constructione libellus* (1515 or earlier), in which Lily, Colet's headmaster at St. Paul's School, had a share. The earliest "Lily" that has been found containing the King's proclamation requiring the book's use is dated 1542.

[2] Reprinted (ed. T. Spira), 1912, in the "Neudrucke frühneuenglischer Grammatiken" series.

[3] Fries, C. C., *The Rules of the Common School Grammars*, Publications of the Modern Language Association, 42 (1927): 225.

drilled as schoolboys; and this apparatus was fastened on English from the start.[4]

This paper will consider what the oldest writers of English grammars have to say about two or three aspects of the noun, and will compare their views on case, especially, with the views of certain grammarians of later times. The early grammars that have been consulted are:

W. Bullokar, *Bref Grammar for English*, 1586.
P. Gr., *Grammatica anglicana*, 1594. For foreigners.
Alexander Gil, *Logonomia anglica*, 1619. For foreigners.
George Mason, *Grammaire angloise*, 1622. For foreigners.
Charles Butler, *The English Grammar*, 1633.
Ben Jonson, *The English Grammar*, 1640. For foreigners.
John Wallis, *Grammatica linguae anglicanae*, 1653. For foreigners.

The presence in Latin of divers declensions and conjugations inspires two English writers, Gil and Jonson, to discover these in their own language. Gil finds three English declensions, distinguished by the plural forms: first, nouns that change the vowel, as *foot, man, mouse* — this class includes the "twofold anomaly" of words in which more than one vowel (really, vowel sound) is changed, e.g. *woman, women*,[5] and words like *sheep* and *swine*, which are the same in both numbers;[6] second, nouns that add *s* or *z* to the singular, as *book, books, thing, thingz* (Gil is using phonetic spelling), again with a twofold anomaly, viz., words that change final *f* to *v*, commonly before the sound of *z*, as *leaf, leaves*, and words that are employed indifferently in singular and plural,

[4] The Latin grammars these men had studied were based on the *Ars grammatica minor* of Aelius Donatus, a Roman schoolmaster of the middle of the fourth century. Donatus' little book was known also as *De octo partibus orationis*, and appeared under this and other titles in England, where it was still being printed in 1577.

[5] More than one vowel is changed in Gil's spelling of these words, *wuman, wimen*. Gil was a spelling reformer, and the English portions of his grammar are printed in the forty characters of his reconstructed alphabet.

[6] "Declinationum differentia petitur a formatione numeri pluralis a singulari: tres proinde sunt declinationes. Prima est nominum quorum figurativa vocalis mutatur in plurali. . . . Est autem hic anomalia duplex: excessus, quum vox plus aequo variatur, ut in *wuman* mulier, *wimen* mulieres, ubi vocalis utraque mutatur; . . . et defectus, quum vox est eadem utrique numero." — *Logonomia anglica* (edition of 1621), in *Quellen und Forschungen zur Sprach- und Culturgeschichte der germanischen Völker*, 90 (1903): 53.

as *money, moneys;*[7] third, nouns whose plurals have an added syllable, as *glass, glasses, ox, oxen.*[8]

Jonson's classification is simpler. In this, there are only two declensions. The first forms the plural by adding *s;* the second, by adding *n*. In Jonson's first declension, Gil's first is included as an exception; and another exception is made of singulars that have no plural, as *gold, bread,* and of plurals that have no singular, as *riches, goods.* Exceptions to the second declension are such words as *man, woman, cow* (plural, *kine*) and *child.* Of *man* and *woman,* Jonson says that these words "by a contraction make *men* and *women,* instead of *manen* and *womenen*"; and his comment on *child* is that "we say not *childen,* which, according to the rule given before, is the right formation, but *children,* because that sound is more pleasant to the ears." Exceptions to both declensions are nouns that add sometimes *s,* sometimes *n,* depending on the dialect, as *houses, housen; eyes, eyen.*[9]

The old Latin grammars varied between five and six genders: masculine, feminine, neuter, common (*hic et haec sacerdos*), epicene or promiscuous (*aquila*), common of three (*hic et haec et hoc felix*). Jonson and Bullokar adopt six. Jonson's epicene stands for both sexes, "especially when we cannot make the difference, as when we call them horses and dogs in the masculine, though there be bitches and mares amongst them; so to fowls, for the most part, we use the feminine."[10] Jonson prefers to call "common" gender by the name "doubtful"; examples are *cousin, gossip, thief.*[11] Bullokar applies "doubtful" to the epicene, and gives common gender the name of "double."[12] Bullokar, though he includes the Latin "common of three," perceives the difficulty of carrying

[7] "Secunda declinatio est nominum quae numero singulari adiiciunt *s* aut *z* in plurali. . . . Et hic anomalia duplex est, una nominum desinentium in *f*, quibus in plurali *f*, plerumque ante *z*, vertitur in *v*. . . . Altera est, quum vox pluralis cum singulari indifferenter usurpatur." — *Ibid.*, pp. 53–54.

[8] "Tertia declinatio imparisyllabica, est vocum quarum pluralis syllaba una excedit singularem." — *Ibid.*, p. 54.

[9] *The English Grammar,* in *The Works of Ben Jonson* (printed for D. Midwinter *et al.*, London, 1756), 7 : 250–251.

[10] *Ibid.*, p. 247.

[11] *The English Grammar*, p. 247.

[12] *Bref Grammar for English,* in *Palaestra,* 52 (1906) : 345–346.

this into English. He remarks that an adjective or participle may be said to be in any of the other genders "in respect of his substantive," in the same sense as an adjective or participle may be said to have case and number, "and the sooner because of conference with other languages that decline adjectives and participles." [13] Jonson, too, notes that in the "common of three" the substantive and the adjective part company, since "a substantive is a noun of one only gender, or (at the most) of two; and an adjective is a noun of three genders, being always infinite." [14] Gil gives three genders, masculine, feminine and neuter.[15] Mason, whose book is in French, names only the two that are found in that language: masculine and feminine.[16] Butler says nothing about gender in connection with the noun — "a noun is a word of number and case" [17] — nor does he mention it in his section on the pronoun.

Jonson's distinction between noun substantive and noun adjective in the passage on the "common of three" is a reminder that the adjective had no independent footing as a part of speech in the early English grammars, but was considered a suborder of the noun, as in Latin; and this in spite of the embarrassment of discussing it in terms of its traditional attributes, gender, number and case. P. Gr.[18] and Gil [19] make the observation that adjectives in general are without distinction of number unless called singular or plural by reason of their attachment to singular or plural substantives; Butler says that "all our adjectives are like the Latin aptote *frugi*, which hath all both numbers and cases under one voice"; [20] and a remark of Bullokar's on the gender of adjectives

[13] *Bref Grammar for English*, in *Palaestra*, 52 (1906): p. 346.

[14] *The English Grammar*, p. 247. [15] *Logonomia anglica*, p. 52.

[16] *Grammaire angloise* (ed. R. Brotanek, 1905, in "Neudrucke frühneuenglischer Grammatiken"), p. 24.

[17] *The English Grammar* (edition of 1634, ed. A. Eichler, 1910, in "Neudrucke frühneuenglischer Grammatiken"), p. 33.

[18] "In adiectivis distinctio numeri nulla est, nisi gratia substantivi singularis aut pluralis, dicantur singularia aut pluralia, ut *sweet apple, sweet apples.*" — *Grammatica anglicana*, p. 9.

[19] "Adiectivis plerisque nulla est differentia numeri, nisi gratia substantivi cui adhaerent, ut *a good man* vir bonus, *good men* viri boni." — *Logonomia anglica*, p. 52.

[20] *The English Grammar*, p. 37.

has been noted. Yet "noun adjective" is the designation employed by all.

Bullokar prescribes for English five of the Latin cases: nominative, genitive, dative (quaintly called by him the "gainative"), accusative and vocative. The gainative comprehends the indirect object and similar constructions, including situations in which there is a "signification contrary to gain," as in the sentence, "He spoiled William a coat." According to Bullokar, the gainative "may be resolved into the accusative case by the preposition *to* or *for*," and the genitive may be resolved likewise. Bullokar does not recognize the ablative — "the case called ablative in Latin or other language is in English the accusative, though governed of a preposition signifying ablatively." [21]

Gil, more slavish than Bullokar, gives all six Latin cases, omitting none. His paradigm of the noun groups together the genitive, dative and ablative, which are distinguished by the "signs" *of*, *to* and *with*, respectively; and groups also the nominative, accusative and vocative, which are without such signs. The inflected form of the genitive is separately discussed.[22] English prepositions govern the same cases as their Latin equivalents. *About, above, according to* and *after* take the accusative, as do *circa, supra, secundum* and *post*. "Others will be considered to govern the ablative," he writes, "because those which require it in the Latin are corresponding terms"; [23] and in this list are found *under* (*sub*), *on* (*super*), *privily* (*clam*), *with* (*cum*) and *than*, as in the sentence, "Her heart is harder than a diamond" (*Cor eius est adamante durius*). Gil has sections on the cases governed by substantives, adjectives and verbs.[24]

Mason also lists six cases.[25] With Butler, however, case is "the different termination of the same word," and hence there are in English but two cases, which Butler calls by the general names of rect and oblique.[26] Specifically, "the rect case of a noun substan-

[21] *Bref Grammar for English*, pp. 340–342.

[22] *Logonomia anglica*, pp. 54–55.

[23] "Ablativum regere censebuntur alia quae sequuntur; quia illis respondent quae casum latinum postulant." — *Ibid.*, p. 87.

[24] *Ibid*, pp. 86–96.

[25] *Grammaire angloise*, pp. 22–23.

[26] *The English Grammar*, p. 32.

tive is the nominative; . . . the oblique is the genitive." The other oblique cases of the Latin are supplied in English by the rect, either with or without prepositions, as the sense will require.[27] The personal pronoun also has two cases, but "the oblique case is not here the genitive, . . . but a case whereof all the Latin obliques are made," as *of thee*, corresponding to the genitive; *to thee*, to the dative; etc. The possessive forms of the three personal pronouns, being adjectives, have, Butler says, no case at all.[28]

Ben Jonson, like Butler, conceives case as formal, mentioning "absolute" and genitive as constituting the declension of a noun.[29] Some of the pronouns, "instead of the genitive, have an accusative case" (here Jonson seems to make "possessives" a separate category), and one of the interrogatives, *who*, has a genitive, in addition to the accusative, form.[30] In the Syntax, the author observes that prepositions, which in the ancient tongues are "coupled, some with one oblique case, some with another," are in English "joined with the accusative cases of pronouns." [31]

P. Gr.'s meager outline, which is especially interested, so the title says, in differences rather than resemblances between English and Latin,[32] takes no account of the case of nouns, but recognizes rect and oblique forms of the pronoun. The oblique case, however, does not include the genitive; forms like *my* and *mine* are listed as adjectives.[33] In the syntax portion of the book P. Gr. remarks that the words *of*, *to* and *from* (which he calls adverbs) reflect, as it were, the case distinctions of the Latin genitive, dative and ablative.[34]

Wallis says that the English language does not recognize a variety of cases, but "we show by means of prepositions everything

[27] *The English Grammar*, pp. 34–35.
[28] *Ibid.*, p. 40.
[29] *The English Grammar*, p. 249.
[30] *Ibid.*, p. 252.
[31] *Ibid.*, p. 282.
[32] The title runs, *Grammatica anglicana, praecipue quatenus a latina differt.* . . .
[33] *Grammatica anglicana*, pp. 14–15.
[34] "Haec tria, *of*, *to*, *from* vel *fro*, casuum quasi discrimina faciunt: *of* servit genitivo; *to* dativo, et pro maiori emphasi utimur *unto; from* vel *fro* ablativo. . . . Utimur etiam pro latinis adverbiis *ad*, *de*, ut ad regem, de rege, *to a king, of a king, from a king.*" — *Ibid.*, p. 34.

that the Latins and Greeks accomplish partly by prepositions and partly by a system of cases." [35] An oblique *forma* or *status*, as well as a rect, is assigned to the pronoun (e.g., rect, *I;* oblique, *me*); the forms *my* and *mine* are possessive adjectives.[36] Wallis avoids the term "case" in connection with the noun, which he refers to as "vox nominativa" or "vox accusativa," [37] calling the possessive form of the noun, as he has called the possessive form of the pronoun, an adjective.[38]

To sum up the paragraphs just preceding, Bullokar admits the nominative and accusative (and vocative), but of the other cases only those whose conceptions *can* be expressed without the aid of prepositions; this accounts for his exclusion of the ablative. His view of case, then, although functional, is moderate, and he may be said to stand between the extreme functionalism which Gil represents and the formalism of Butler, Jonson and Wallis, all of whom limit noun cases to two, and since they regard the possessive as an adjective, limit the cases of pronouns, in the main, to two also.

Wallis is the most advanced of the grammarians thus far considered, as well as the latest in time. He is not unmindful of the labors of such predecessors as Gil and Jonson, he says in his Preface, but these men have inculcated "many useless precepts about cases, genders, and declensions of nouns; tenses, modes, and conjugations of verbs; government of nouns and verbs; and other similar matters which are entirely foreign to our language, and produce confusion and obscurity rather than understanding"; for in English almost the whole syntax of the noun is performed by prepositions, and the conjugation of verbs by auxiliaries.[39]

[35] "Diversitatem casuum (quos habent praesertim Graeci et Latini) anglicana lingua neutiquam agnoscit; sed praepositionum auxilio rem omnem illam praestamus quam Graeci et Latini partim praepositionibus partim casuum diversitate perficiunt." — *Grammatica linguae anglicanae* (4th edition, 1674), p. 62. [36] *Ibid*, p. 76. [37] *Ibid.*, pp. 62–63. [38] *Ibid.*, p. 69.

[39] "Omnes . . . multa inutilia praecepta de nominum casibus, generibus, et declinationibus, atque verborum temporibus, modis, et coniugationibus, de nominum item et verborum regimine, aliisque similibus tradiderunt, quae linguae nostrae sunt prorsus aliena, adeoque confusionem potius et obscuritatem pariunt, quam explicationi inserviunt. . . . Tota nempe nominis syntaxi praepositionum fere auxilio praestita, et verborum coniugatione facili

Most of the grammars published from 1580 to the end of the seventeenth century were intended either to guide foreigners in the acquisition of English, or to facilitate the mastery of Latin by schoolboys.[40] In the latter class may perhaps be put Bullokar's *Bref Grammar* on the strength of the author's avowal that one of his two aims is the "easier coming to the knowledge of grammar for other languages," and here belongs John Stockwood's somewhat mistitled *A Plain and Easy Laying Open of the Meaning and Understanding of the Rules of Construction in the English Accidence* (1590).[41] These are the earliest two. The grammars of the eighteenth century, however, were usually designed to reduce the language to rule, or to correct English usage by making it conform to a standard of "reason." [42] In the after part of that century, before the advent of Lindley Murray, three of the most influential books were Robert Lowth's *A Short Introduction to English Grammar* (1762), William Ward's *A Grammar of the English Language* (1765), and Charles Coote's *Elements of the Grammar of the English Language* (1788).

Both of the case traditions already observed in the earlier period are still in evidence. Lowth and Coote keep the noun cases down to two, on a basis of form. Coote echoes Lowth in the following passage: "With respect to the cases, or different terminations of nouns, serving to express the various relations of one thing to another, it may be observed that the English, for the same purpose, make use of prepositions. Our substantives, therefore, remain unvaried, except that we may be said to have two

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auxiliarium ope peracta, illud levissimo negotio peragitur, quod in aliis linguis ingentem solet afferre molestiam." — *Grammatica linguae anglicanae.*

[40] C. C. Fries, *The Teaching of the English Language*, p. 10.

[41] In his address to the "friendly reader," Stockwood says he has "made choice to deal with the English rules, because it is the first thing that the accidentiaries do enter into after they have learned the eight parts of speech, and as it were the foundation of all the rest of the grammar building, the which being well laid, they shall be the better able to proceed to the understanding of Latin authors." The book was intended as an elucidation of Lily's Grammar, with which the author recommended that it be bound. The Latin rules, in English, are accompanied by examples in Latin, with their English equivalents.

[42] Fries, *loc. cit.*

cases; one of which is the nominative, and merely expresses the name of the thing, while the other represents possession or belonging, and answers to the Latin genitive." [43]

Of the pronoun, Lowth says: "Pronouns have three cases: the nominative; the genitive, or possessive, like nouns; and moreover a case which follows the verb active or the preposition, expressing the object of an action or of a relation. It answers to the oblique case in Latin, and may be properly enough called the objective case." [44] Coote excludes the possessive here, restricting the pronoun to "nominative or first case, and that which follows a verb active or a preposition, for which reason it may be called the subsequent case; but, as it expresses the object of an action or of a relation, the name objective case, which Dr. Lowth has given it, will better represent its use." [45] He looks on the "possessive" pronouns *my, his* and the others (except *its*, to which he allows a genitive or possessive case) as forming a class distinct from the "personals." [46]

Ward writes in his Preface: "As no man knows but he may have occasion to learn some other language, why should he not be taught the English rudiments in such a manner as may be of service towards his learning any other language? . . . The effect of the declension and cases of nouns, and of the conjugation of verbs, is and must be in every language: Why then may not those grammatic forms of nouns and verbs which produce the same effects in different languages be called by the same grammatic names?" [47] Ward is a thoroughgoing functionalist, a Gilian of the purest luster. "The forms of each number may be considered as six, and called cases, in imitation of the Latin forms of substantives, with which they nearly correspond *in meaning;* and the established name of each case may be retained." [48] He shackles

[43] *Elements of the Grammar of the English Language* (1788 edition, C. Dilly, London), pp. 49–50. Cf. Lowth, *A Short Introduction to English Grammar* (1800 edition, Bonsal and Niles, Wilmington), pp. 21–22.

[44] *A Short Introduction to English Grammar*, p. 26.

[45] *Elements of the Grammar of the English Language*, pp. 59–60.

[46] *Ibid.*, p. 61.

[47] *A Grammar of the English Language* (1767 edition, A. Ward, York), p. vii.

[48] *Ibid.*, p. 20.

the adjective again to its old master, the noun, and omits it from the parts of speech (in Lowth and Coote the adjective is autonomous). He prescribes only one regular declension for substantives, but this has four subordinate varieties. The main declension adds *s* in the plural without increasing the number of syllables, as *king, kings;* the rules for the several "varieties" — like all of Ward's rules, cast in couplets — are as follows: [49]

1. *Es* is the plural of the silent *e*,
   Preceded by an *s*, *z*, *c*, or *g*.
2. *Y* final, not in diphthongs used, supplies
   Its plural by the termination *ies*.
3. *C-h*, *s*, *s-h*, *x* and *z* increase
   Their plural forms by each assuming *es*.
4. *F* single, or with silent *e*, if closed,
   Takes plural forms by *v-e-s* composed;
   Except *dwarf*, *wharf*, *hoof*, *proof*, with *grief*, *relief*, *Fife*, *strife*, *brief*, *mischief*, *handkerchief* and *chief*.

Murray's place in English grammar in the nineteenth century, which saw his book run through more than two hundred editions, is comparable to Lily's in Latin grammar in the seventeenth. The *English Grammar* was first published in 1795. The Introduction acknowledges the author's indebtedness to Lowth, Coote and others, and calls the grammatical part proper of the work a compilation of their materials.[50] "For the assertion that there are in English but two cases of nouns, and three of pronouns, we have the authority of Lowth, Johnson, Priestley, and others, names which are sufficient to decide this point," Murray wrote in the first ten or eleven editions.[51] Afterward he took what A. E. Sonnenschein calls the "momentous step" of recognizing the objective case of substantives, defending the innovation on the ground that "there are many instances, both in Greek and Latin, in which nominative and accusative cases have precisely the same form, and are distinguished only by the relation they bear to other words in the

[49] *A Grammar of the English Language* (1767 edition, A. Ward, York), pp. 24–25.

[50] *English Grammar* (1819 edition, E. and E. Hosford, Albany), p. 5.

[51] Quoted from the second edition (1796) by Goold Brown, *The Grammar of English Grammars* (1875), p. 261.

sentence." The adoption of such a case, he adds, will expedite the business of parsing, and "the irregularity of having our nouns sometimes placed in a situation in which they cannot be said to be in any case at all, will be avoided." [52]

Sonnenschein says that in accepting the objective case of the noun, Murray "rendered English grammar the service of liberating it from the false definition of 'case' by which his predecessors had been hampered; for he thus opened the door to the admission of a dative case — a case which is syntactically distinct from the accusative, though it does not differ from it in form in modern English." [53] And so the dative enters, on Professor Sonnenschein's arm, the door that Lindley Murray threw open. Sonnenschein's system of cases, nominative, vocative, accusative, genitive and dative — only the ablative is wanting — is precisely that of Bullokar; and in 1923, the date of *A New English Grammar*, we are back where we started in 1586.

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[52] *English Grammar*, p. 51.
[53] *A New English Grammar*, Preface to Part II, p. 5.

THEORIES OF POETIC DICTION IN WORDSWORTH AND OTHERS AND IN CONTEMPORARY POETRY

ALEXANDER BREDE

THIS paper aims to present the theory or opinion of Goldsmith, Wordsworth, Coleridge, De Quincey and our contemporary poets on the diction or language of poetry, particularly with reference to the development of the plain style in English verse. These writers are essentially in agreement on what the diction of poetry should be. Their opinions, and practice, also, adequately demonstrate that the theory of the early twentieth century returns to the theory of the early nineteenth. Theory and practice of both periods have their origin in reaction to an artificial style which was the vogue, in the main, during the middle of the eighteenth and nineteenth centuries. As much as possible I shall let the poets speak for themselves.

On this subject there is a great deal of carelessness in language; much confusion exists in the use of the words "diction" and "language." Much of the difference of opinion arises from just this cause, especially the difference between Wordsworth and Coleridge. I have not avoided the confusion, accepting these words as my authors used them, as will become plain as we proceed. A distinction should be maintained between "diction," "phraseology," "style" and "language"; but only incidentally have I touched upon this, my purpose being to show what these authors have stated on the subject. However, sometime we shall have to decide whether Wordsworth meant "diction" when he wrote "language" and whether Coleridge took him to mean "language" when he wrote "diction."

I

In three works Goldsmith has expressed his ideas of poetic diction, but rather indirectly in criticism of other writers. There

is something in the *Essays* of 1765; something in number 8 of *The Bee* (Nov. 24, 1759), and a paragraph in the *Life of Dr. Parnell* of 1770.

The essay in *The Bee* is *An Account of the Augustan Age of England*. Toward the end of it Goldsmith attempts to find a reason for the decay of poetry in his own day. He says the poet is "content, if he can give music instead of sense; content, if he can paint to the imagination without any desires or endeavours to effect; the public therefore with justice discard such empty sound, which has nothing but a jingle, or what is worse, the unmusical flow of blank verse to recommend it." [1] Stated positively, a poem ought to have sense and ought to affect the imagination. Thus there is some dissatisfaction with the poetry of his time.

In the essay *Taste* he has a few examples of simplicity of diction, a quality which he admires. One of these is the exclamation of Anaxagoras, the teacher of Pericles, when he learned that his two sons were dead: "I knew they were mortal." The other is that of Macduff when he heard that Macbeth had killed his children: "He has no children." These sentences, says Goldsmith, are "the most expressive perhaps that were ever uttered." And then he adds, "This is the energetic language of simple Nature, which is now grown into disrepute." These statements indicate his general disposition in the matter of diction. From it we may conclude that he prefers the "language of simple nature." [2] Yet he does not seem ready to put his idea into a positive theory. He states it, also, somewhat modified, in the essay *Cultivation of Taste:* "If we consider Poetry as an elevation of natural dialogue, . . . we must allow that Poetry is a perfection to which Nature would gladly aspire." [3]

But in another essay, *Poetry Distinguished from Other Writing*, he takes somewhat the opposite point of view and seems to support the "poetic" diction which the "natural dialogue" would seek to tear down. If the histories of Polybius and Livy were "turned into verse, they would not become Poems, because they would be destitute of those figures, embellishments, and flights of imagina-

[1] *Miscellaneous Works* (London, 1812), 4 : 291.
[2] *Ibid.*, p. 377 (Essay XII, *Taste*). [3] *Ibid.*, p. 389 (Essay XIII).

tion, which display the Poet's art and invention." Poetry is distinguished "undoubtedly by its own peculiar expression: it has a language of its own, which speaks . . . feelingly to the heart, and . . . pleasingly to the imagination. . . . It is a species of painting with words, in which the figures are happily conceived, ingeniously arranged, affectingly expressed, and recommended with all the warmth and harmony of coloring." He illustrates by quoting from Homer and from Pope's translation. He does not blame Pope "for deviating . . . from the simplicity of Homer." "Homer mentions a person who played upon a lyre." Pope "sets him before us warbling to the silver strings." And this Goldsmith considers an improvement. But he objects to such a verse as

> The sea. . . . . .
> Exults and crowns the monarch of the main,

since it is not in the original. Farther on he repeats his belief in "poetic" diction:

> There are certain words in every language particularly adapted to the poetical expression; some from the image or idea they convey to the imagination; and some from the effect they have upon the ear. The first are truly figurative; the others may be called emphatical.

The figurative are exemplified by Shakespeare's "hangs" in

> . . . halfway down
> Hangs one that gathers samphire, dreadful trade.

The emphatic are plainly "such as by their sounds express the sense they are intended to convey," for instance, "twanging bow." [4]

"Poetic" diction is thus to a great extent figurative language. But Goldsmith is level-headed; he sees the defects as well as the excellences of the poetry of his time. In *Metaphors* he gives a caution:

> The danger is in sowing metaphors too thick, so as to distract the imagination of the reader, and incur the imputation of deserting Nature, in order to hunt after conceits. Every day produces poems . . . so inflated with metaphor, that they may be compared to the gaudy bubbles blown up from a solution of soap.

[4] All the passages in this paragraph are from the same source, pp. 405–414 (Essay XV, *Poetry Distinguished from Other Writing*).

And in regard to pathos, the poet "must . . . carefully distinguish between those metaphors which rise glowing from the heart, and those cold conceits, which are ingendered in the fancy," for one of the last might "destroy the whole effect of the most pathetical incident." [5]

In the *Life of Parnell* we come back to the "natural language" idea. Dryden, Addison and Pope brought the language to "the highest pitch of refinement," but their successors "involve it into pristine barbarity" by their "antiquated words and phrases, . . . the most licentious transpositions, and the harshest constructions, [so] that the more their writings are unlike prose, the more they resemble poetry." But Parnell is free from all this; "he has considered the language of poetry as the language of life, and conveys the warmest thoughts in the simplest expression." [6] This is, of course, only an indirect statement of Goldsmith's belief; yet his admiration for Parnell's language leads us to suspect that he preferred Parnell's diction to the other.

Goldsmith seems to take a middle ground between Pope and Wordsworth, with a leaning toward the former. He realizes the defects of the so-called "poetic" diction, but he does not go so far as to denounce it as Wordsworth does. Moreover, he cannot quite bring himself to follow out in theory the implications of his statements that poetry should be in the "language of life." The time was not yet.[7]

II

A few paraphrases will suffice to illustrate the kind of diction usually termed "poetic." In the "Song of Deborah" we read:

> He asked for water, and she gave him milk; she brought him forth butter in a lordly dish.

This becomes in Francis Fawkes' hand,

> He ask'd refreshment from the limpid wave,
> The milky beverage to the chief she gave.

[5] *Miscellaneous Works*, pp. 415, 417 (Essay XVI). [6] *Ibid.*, p. 22.

[7] I have not consulted Goldsmith's poems to ascertain his diction in his practice, but evidence of his belief is likely to be found there; cf. "When lovely woman stoops to folly."

Homer has a passage which reads,

> Thus spake she wailing, and stirred unending moan.
> Then thirdly Helen led their sore lament.

But Pope puts it,

> Thus spoke the dame, and melted into tears.
> Sad Helen next in pomp of grief appears;
> Fast from the shining sluices of her eyes
> Fall the round crystal drops, while thus she cries.

An anecdote in Boswell records Dr. Grainger in *The Sugar Cane* changing his *mice* into *rats* and the *rats* into "the whisker'd vermin race." A tobacco pipe, to give one more illustration, was "the short tube that fumes beneath the nose." [8]

To things of this sort Wordsworth opposed his theory. His objection we find stated in a number of passages. He usually speaks of them with contempt. In the "Advertisement" to the *Lyrical Ballads* of 1798 he refers to them as "the gaudiness and inane phraseology of many modern writers." [9] This is repeated in the Preface of 1800.[10] They are artificial,[11] "arbitrary and subject to infinite caprices." [12] In the *Essay Supplementary to the Preface*, 1815, in discussing the original poems of Bishop Percy, Wordsworth says that the Bishop "adopted . . . a diction scarcely in any one of its features distinguishable from the vague, the glossy, and unfeeling language of his day." [13]

Wordsworth's theory was directed, also, against the notion of his predecessors and contemporaries of the eighteenth century that poetry had a "language peculiar to itself." This view is well stated in a letter of Thomas Gray to R. West in 1742:

> The language of the age is never the language of poetry except among the French, whose verse, where the thought or image does not support it, differs nothing from prose. Our poetry, on the contrary, has a language peculiar to itself: to which almost everyone, that has written, has added something by

[8] These illustrations are all taken from Lowes, *Convention and Revolt in Poetry*, pp. 208–211.

[9] Knight edition of *Prose Works*, 1 : 31.

[10] *Ibid.*, p. 47.

[11] *Ibid.*, p. 49.

[12] *Ibid.*, p. 64.

[13] *Ibid.*, 2 : 243.

enriching it with foreign idioms and derivations: nay sometimes words of their own composition or invention.[14]

Johnson is of the same opinion, as he negatively stated in his *Life of Dryden*:[15]

> There was before the time of Dryden no poetical diction, no system of words at once refined from the grossness of domestic use, and free from the harshness of terms appropriated to particular arts. Words too familiar, or too remote, defeat the purpose of a poet.

In any consideration, then, of Wordsworth's theory, the fact that he was trying to free poetry from the shackles of the "poetic" diction of his age must not be lost sight of.

Wordsworth's theory is not to be found in a single statement but in several, for he was constantly modifying and explaining what he meant by "the language of men." Each passage bearing on his theory of diction must be considered not singly, but in the light of all that he writes on it. Because certain passages have been isolated and in the popular mind made to stand for the theory, Wordsworth's theory has been misunderstood and "willfully misinterpreted." [16] The critics, says De Quincey, fancied that Wordsworth meant that "whatsoever was plebeian was also poetically just in diction . . . as though the vernacular phrase were universally the impassioned." [17] Wordsworth is not altogether free from blame, for he seems to have been unable to say exactly, clearly and concisely what he did mean. If in writing his theory he had only taken his eye off the rustic and trained it on himself he would have come nearer to what he meant. Nor was he careful to discriminate in the use of words: there is confusion in his use of the terms "diction" and "language."

The "Advertisement" to the first edition of the *Lyrical Ballads* actually did state almost what Wordsworth has always been accused of saying:

[14] Quoted in R. P. Cowl, *Theory of Poetry in England*, p. 198. Saintsbury (*History of Criticism*, 3 : 56) is of opinion that this letter may have aroused Wordsworth's ire and so led to the theory.

[15] Cowl, *op. cit.*, pp. 203–204 (an extract).

[16] *Biog. Lit.*, Chap. XCIII (Shawcross ed.).

[17] "On Wordsworth's Poetry," in Alden, *Critical Essays of the Early Nineteenth Century*, p. 330.

> [The Poems] were written chiefly with a view to ascertain how far the language of conversation in the middle and lower classes of society is adapted to the purpose of poetic pleasure.[18]

But this statement was as much an experiment in expressing a theory as the poems were an experiment in the application. In 1800, he writes that for the poems —

> Humble and rustic life was generally chosen, because in that condition the essential passions of the heart find a better soil, . . . are less under restraint, and speak a plainer and more emphatic language; because in that condition of life our elementary feelings coexist in a state of greater simplicity, and consequently may be more accurately contemplated, and more forcibly communicated; because the manners of rural life germinate from those elementary feelings; and from the necessary character of rural occupations are more easily comprehended, and are more durable; and lastly, because in that condition the passions of men are incorporated with the beautiful and permanent forms of nature.[19]

The term "rustic life" was unfortunately used; but obviously, if Wordsworth had meant to write in the language of rustics, he would have had to write dialect poems after the fashion of Tennyson in "The Northern Farmer":

> Wheer 'as ta beän saw long and me ä liggin' 'ere aloän?
> Noorse? thoort nowt o'a noorse: whoy, Doctor's abeän an' agoän.

Even so, this is the language of rustics only so far as Tennyson's ear ascribes it to them. It is the poet's collocation, concatenation or grouping of the individual words that makes the language of *The Northern Farmer* different from the actually spoken language.

This first statement of the theory has been modified into (1) "a selection of the real language of men in a state of vivid sensation";[20] (2) "my purpose was to imitate, and, as far as possible, to adopt the very language of men";[21] (3) "language closely resembling that of real life";[22] (4) "endeavored to bring my language near to the real language of men."[23] This is further modified and expanded.

[18] *Prose Works* (Knight ed.), 1 : 31.
[19] Alden, *op. cit.*, p. 3. Preface to the *Lyrical Ballads*.
[20] Alden, *op. cit.*, pp. 1, 3, 10. This and the following references are from the Preface of 1800.
[21] *Ibid.*, p. 6. [22] *Ibid.*, pp. 21, 22, 23. [23] *Ibid.*, pp. 7, 21.

The language of these men has been adopted (purified indeed from what appear to be its real defects, from all lasting and rational causes of dislike or disgust) because such men hourly communicate with the best objects from which the best part of language is originally derived; and because, from their rank in society and the sameness and narrow circle of their intercourse, being less under the action of social vanity, they convey their feelings and notions in simple and unelaborated expressions.[24]

On the point of "selection" Wordsworth is insistent: "This selection, wherever it is made with true taste and feeling, will of itself form a distinction far greater than would at first be imagined, and will entirely separate the composition from the vulgarity and meanness of ordinary life." [25]

If the poet's subject be judiciously chosen, it will naturally . . . lead him to passions the language of which, if selected truly and judiciously, must necessarily be dignified and variegated.[26]

The poet has the faculty of seeing and comprehending the universe and of expressing what he sees and feels; but the language in which he expresses himself "must often, in liveliness and truth, fall short of that which is uttered by men, in real life under the actual pressure of those passions, certain shadows of which the poet thus produces, or feels to be produced, in himself." The poet wishes "to bring his feelings near to those of the persons whose feelings he describes . . . and even confound and identify his own feelings with theirs; modifying only the language which is thus suggested to him by a consideration that he describes for a particular purpose, that of giving pleasure. Here, then, he will apply the principle of selection." There will be no necessity for him "to trick out or to elevate Nature"; and the more "he applies the principle, the deeper will be his faith that no words which *his* fancy or imagination can suggest will be to be compared with those which are the emanations of reality and truth.[27]

There is one other passage in this connection:

[24] Alden, *op. cit.*, p. 4.

[25] *Ibid.*, p. 10. Does not Wordsworth sometimes confuse selection of material with selection of diction?

[26] *Ibid.*, p. 10.

[27] Alden, *op. cit.*, pp. 11–12. The construction of the last sentence seems to me awkward; but I let it pass.

The poet thinks and feels in the spirit of human passions. How, then, can his language differ in material degree from that of all other men who feel vividly and see clearly?

If poets wrote for poets alone, he says, then "The poet might be allowed to use a peculiar language." But poets write for men; hence "in order to excite rational sympathy, he must express himself as other men express themselves. . . . While he is only selecting from the real language of men, or, which amounts to the same thing, composing accurately in the spirit of such selection, he is treading upon safe ground." [28]

It is seen that Wordsworth emphasizes the idea of the "selection" of the real language of men, and this "as far as possible." He might have been more definite on "real language" and "men." Unfortunately, his theory of diction was so closely connected with the subject matter of the early poems — "incidents and situations from common life" — that they were soon thought to be inseparable. And perhaps he did fail to distinguish the two sufficiently to prevent misconceptions arising. Since Wordsworth had "generally chosen" humble and rustic life, it was carelessly assumed that rustic language was to be the medium of expression and that this was the language of men. But, as Professor Lowes has suggested, Wordsworth's own language and that of his peers is as much the "language really used by men" as that spoken by Betty Foy.[29] Wordsworth would have been nearer to his idea, I think, if he had said that he would write in a selection of his own ordinary language, the language spoken under pressure of the emotions. This, I feel, is what he meant. Perhaps we should take him for what he really meant rather than for what he actually said.[30]

In the Appendix to the *Lyrical Ballads*, 1802, Wordsworth himself has said as much; at least we may infer that what he said there is to be taken as part of his theory.

The earliest poets . . . generally wrote from passion excited by real events: they wrote naturally and as men; feeling powerfully as they did, the

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[28] Alden, *op. cit.*, p. 17.

[29] J. L. Lowes, *op. cit.*, pp. 216–217.

[30] As an example of language spoken under pressure of the emotions, see the speech of Vanzetti to the judge before passing of sentence.

language was daring and figurative.[31] In the succeeding times, poets . . . without being animated by the same passion, set themselves to a mechanical adoption of these same figures of speech . . . and thus insensibly produced [a language] differing materially from the real language of men in any situation.[32]

Hence was produced a distorted language, a passionless or artificial diction, the "poetic" diction against which Wordsworth directed his theory. Further he says:

It is indeed true that the language of the earliest poets was felt to differ materially from ordinary language, because it was the language of extraordinary occasions; but it was really spoken by men, language which the poet himself had uttered when he had been affected by the events which he described, or which he had heard uttered by those around him.

"Language which the poet himself had uttered" — is it not a significant phrase?

One other point should be mentioned. "There neither is, nor can be," he says, "any *essential* difference between the language of prose and metrical composition." [33] If we remember that Wordsworth has italicized "essential," I think we shall have no quarrel with him. He does not say there is no difference between prose and verse, but that there is none between the language of these two mediums. I do not think that Wordsworth's theory implies that there are no phrases appropriate to verse which would be out of place in prose.[34]

Now how has Wordsworth applied the theory? Critics in general have delighted in saying something to the effect that he could not write good poetry at all "without putting [his] principle in[to] his pocket." [35] He wrote bad poetry; but I suspect it was bad because he forgot that his principle demanded that "the language of real men" must be charged with emotion to be poeti-

[31] "All good poetry is the spontaneous overflow of powerful feelings." — Preface, 1800; in Alden, *op. cit.*, p. 5.

[32] *Prose Works* (Knight ed.), 1 : 77-78. The following passage also is from this source.

[33] Preface of 1800, Alden, *op. cit.*, p. 9.

[34] Saintsbury, *op. cit.*, 3 : 211, seems to have missed the force of "essential." Coleridge discusses it at length. "Essential" might be interpreted as "fundamental." There seems also to be a faulty comparison here.

[35] *Ibid.*, p. 202. Cf. Walter Raleigh, *Wordsworth*, p. 90.

cally useful. He used this language to great effect in some poems and to little in others.

In the *Lucy* poems he wrote the ordinary language of men, but he suffused it with emotion. And this (on a basis of metre, of course) transforms the plain words into poetry. The stanza

> She lived unknown, and few could know
> When Lucy ceased to be;
> But she is in her grave, and, oh,
> The difference to me!

has been both admired and parodied; but here is the language really used by men wrought into the fabric of poetry. Or take a passage or two from *Michael*:

> An old man stout of heart, and strong of limb
> His bodily frame had been from youth to age
> Of an unusual strength: his mind was keen,
> Intense, and frugal, apt for all affairs,
> And in his shepherd's calling he was prompt
> And watchful more than ordinary men.
>
> And truly, at all times, the storm, that drives
> The traveler to a shelter, summoned him
> Up to the mountains: he had been alone
> Amid the heart of many thousand mists.

These passages are from the language common to ordinary life and prose; but they, also, have been imbued with emotion and penetrated with imagination.[36] This is a selection of Wordsworth's own diction, for Michael never could have expressed himself thus;[37] and yet it is in a natural and not a "poetic" diction. The same sort of diction we find in the sonnets, in the *Lines Composed above Tintern Abbey*, in the *Ode to Duty*, in the *Ode on Immortality* and many others.

[36] This view is confirmed by Walter Raleigh, *op. cit.*, p. 102: "While passion holds him, while he is moved or exalted, his language keeps its naked intensity . . . but when his own feeling flags," and in explanatory or transitional passages, he is often flat or ornamental. Cf. also p. 114: "Everywhere, when his deepest and sincerest feelings are touched, his language answers to them, and becomes simple, more matter-of-fact."

[37] J. L. Lowes, *op. cit.*, pp. 188, 217.

When Wordsworth's poems are bad, they are bad for the same reason that he says the following parody by Johnson is bad; not because of the diction used, but because "the *matter* expressed . . . is contemptible."

> I put my hat upon my head
> And walked into the Strand,
> And there I met another man
> Whose hat was in his hand —

It "wants sense" and "the images neither originate in that sane state of feeling which arises out of thought, nor can excite thought or feeling in the reader." [38] This it seems to me should be our criticism of the objectionable parts of such poems as *Peter Bell*, *The Idiot Boy*, *Alice Fell*, *The Thorn*, *The Blind Highland Boy*, *Anecdote for Fathers*. In passages like the following the fault is that no emotion has been breathed into the context or situation, and that the diction is not appropriate to the emotion the poet feels or wishes the reader to feel; hence it becomes "the apotheosis of the prosaic." [39]

> "Now, little Edward, say why so:
> My little Edward, tell me why." —
> "I cannot tell, I do not know." —
> "Why, this is strange," said I.[40]

> Not five yards from the mountain path,
> This thorn you on your left espy;
> And to the left, three yards beyond,
> You see a little muddy pond
> Of water — never dry,
> Though but of compass small and bare
> To thirsty suns and parching air.

This last couplet originally had been the surveyor's report:

> I've measured it from side to side,
> 'Tis three feet long, and two feet wide.[41]

Here is too much inconsequential reality: guidebook direction and report. And why "water"? It is unsuitable because it is superfluous and has no emotional content in the context, though it is

[38] Preface of 1800, in Alden, *op. cit.*, p. 23.
[39] J. L. Lowes, *op. cit.*, p. 214.
[40] *Anecdote for Fathers.* [41] *The Thorn.* Too stark reality.

not unpoetical. Compare the "five yards" and the "water" of this with the "five years" and "the waters" of the passage following and note when the same words are poetically used and when not.

> Five years have past; five summers, with the length
> Of five long winters! and again I hear
> These waters, rolling from their mountain-springs
> With a soft inland murmur.

Aside from the facts of emotion, imagination and metre, these are poetry because the diction is employed with a noble simplicity and not a mere simplicity.[42]

> A household tub, like one of those
> Which women use to wash their clothes,

in which the blind boy went to sea, becomes, under criticism,

> A shell of ample size, and light
> As the pearly car of Amphitrite,
> That sportive dolphins drew,[43]

and Wordsworth falls into the "poetic" diction that he condemned. Both versions are faulty; one is too close to literal fact and the other, artificial. But not faulty because of the diction merely, for I suspect, in the hands of perhaps such a writer as Burns, even the "household tub" might become poetical.

Professor Raleigh puts these defects on a different basis. His view is that Wordsworth distorts the natural prose or speech order of words and phrases at the expense of "natural idiom and natural cadence" to satisfy rime and metre. He quotes from *The Thorn* the following in illustration:

> You must take care and choose your time
> The mountain when to cross.

Wordsworth, he says, also disregards the common associations of words and imbues them with feelings and connotations they do not ordinarily possess. "Idiot" and "ass" are instances. These will retain their vulgar associations, despite the efforts of the poet to purify them. The trouble is not so much with the poet's diction

[42] J. L. Lowes, *op. cit.*, pp. 217–218. [43] *The Blind Highland Boy.*

as with his imagination, with the habitual working of his mind. For him, mere fact and bare statement are enough; but mere fact and bare statement are often not enough for the reader, because of the general inadequacy of language to communicate accurately the poet's thoughts and feelings, because words are "deceitful, clumsy, unmanageable and tricky." [44]

Wordsworth was not unaware that his poems had faulty passages, which presented the ludicrous rather than "tender and pathetic" feeling.[45] But he had no sense of humor to distinguish what these passages were. And he sometimes forgot, as these extracts show, to recollect in tranquillity the emotion of a particular situation before attempting to give it expression. Moreover, the publication of his theory called attention to his own application of it and drew upon his head condemnation for these defective poems which otherwise his readers would have passed by as not worthy of his genius.

III

Though Coleridge [46] was associated with Wordsworth in the publication of the *Lyrical Ballads*, he "never concurred" in many parts of the Preface, "but on the contrary objected to them as erroneous in principle, and as contradictory . . . both to other parts of the same preface, and to the author's own practice" in most of the poems.[47] He seems to have shared Wordsworth's dislike for gaudy and glittering diction; for he says in the first chapter of the *Biographia Literaria* that his own early work was defective "with an excess of ornament in addition to strained and elaborate diction," and that he tried "to tame the swell and glitter both of thought and diction." [48] The moderns, he says, put "the most obvious thoughts in language the most fantastic and arbitrary." Pope's translation of Homer is "the main source of our

[44] Walter Raleigh, *op. cit.*, pp. 91–92, 95–101, 115–116.

[45] Preface of 1800, in Alden, *op. cit.*, p. 22.

[46] In my investigation I may not have done justice to Coleridge, for I investigated only his *Biographia Literaria*; but his *Anima Poetae*, *Table Talk* and *Letters* ought also to be consulted.

[47] *Biog. Lit.*, Chap. XIV, p. 162 (Everyman's Library). Unless otherwise stated, all references to *Biog. Lit.* are to this edition.

[48] *Ibid.*, Chap. I, pp. 2–3.

pseudo-poetic diction," while "Cowper and Bowles were, to the best of [his] knowledge, the first who combined natural thoughts with natural diction." [49]

My discussion of Coleridge's dissection of Wordsworth's Preface will be concerned with the criticism both of "the selection of the real language of men" and of the lack of "any essential difference between the language of prose and metrical composition."

He criticizes first the passage which I have quoted above,[50] that "humble and rustic life was generally chosen because in that condition the essential passions . . . speak a plainer and more emphatic language." The characters in *The Brothers, Michael, Ruth, The Mad Mother,* he says, "are by no means taken from low or rustic life in the common acceptation of those words: and it is not less clear, that the sentiments and language, as far as they can be conceived to have been really transferred from the minds and conversation of such persons, are attributable to causes and circumstances not necessarily connected with 'the occupations and abode' [as Wordsworth says]. The thoughts, feelings, language, and manners of the shepherd-farmers in the vales of Cumberland and Westmoreland, as far as they are actually adopted in those poems, may be accounted for from other causes," of which he names two: the independence and the education of the farmers.[51] These are good poems, however, because they satisfy his poetic creed, which is this:

> I adopt with full faith, the principle of Aristotle, that poetry . . . is essentially ideal; that its apparent individualities of rank, character, or occupation must be representative of a class; and that the persons of poetry must be clothed . . . with the common attributes of the class: not with such as one gifted individual might possibly possess.

According to this, then, *The Brothers* and *Michael* "have all the verisimilitude and representative quality, that the purposes of poetry can require." But in such poems as *Harry Gill, The Idiot Boy,* "which are pitched in a lower key, . . . the feelings are those of human nature in general." [52]

Then he takes up the passage "The language, too, of these

[49] *Biog. Lit.*, Chap. I, pp. 12–13, 21 (note).
[50] Page 543.
[51] *Biog. Lit.*, Chap. XVII, p. 181.
[52] *Ibid.*, p. 183–184.

men has been adopted (purified indeed from what appear to be its real defects, from all lasting and rational causes of dislike or disgust)" and leaves it baseless: [53]

> A rustic's language, purified from all provincialism and grossness, and so far reconstructed as to be made consistent with the rules of grammar . . . will not differ from the language of any other man of common sense, however learned or refined he may be, except as far as the notions, which the rustic has to convey, are fewer and more indiscriminate. . . . The rustic . . . aims almost solely to convey insulated facts . . . while the educated man chiefly seeks to discover and express those connections of things . . . from which some . . . general law is deducible.[54]

Coleridge objects particularly to "the best part of language" which is "originally derived" from "the best objects" with which the rustic "hourly communicates." The rustic has only a "scanty vocabulary" because of his limited scope, and this "scanty vocabulary" can hardly "form the best part of language." "The best part of language," he says, "is derived from reflection on the acts of the mind itself"; and that implies the mind of educated man, chiefly. But through the processes of religion and education the rustic acquires some of the vocabulary of the educated.[55]

We might pause a moment and ask, What exactly did Wordsworth mean by "best"? This word seems as unfortunately chosen as "rustic." May it not be that Wordsworth meant by it the elemental or fundamental part, that is, the Saxon part of the language, in which our ordinary needs and concerns — our fundamental thoughts and emotions — are communicated and expressed?

Coleridge dislikes the word "real" in "a selection of the real language of men" and substitutes "ordinary" or "*lingua communis*," for this is what results when each person's speech is pruned of its peculiarities.[56] Nor does the addition of the words "in a state of excitement" alter the language, for

> the nature of a man's words, where he is strongly affected by joy, grief, or anger, must necessarily depend on the number and quality of the general

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[53] Quoted on page 544.
[54] *Biog. Lit.*, p. 187.
[55] *Ibid.*, pp. 187–188.
[56] *Ibid.*, p. 189.

truths, conceptions, and images and of the words expressing them, with which his mind had been previously stored.[57]

Finally, the order of the language of the uneducated is different from that in which Wordsworth has put the language of the rustic. Hence the order must be Wordsworth's, because the rustic cannot foresee the whole of what he is going to say.[58]

The foregoing paragraphs state Coleridge's idea only negatively and as far as he disagrees with the actual wording of Wordsworth's theory. In his discussion of the other division, that on the passage, "There neither is nor can be any essential difference between the language of prose and metrical composition," he states his idea more positively:

"The true question must be, whether there are not modes of expression . . . which are in their fit and natural place in a serious prose composition, but would be disproportionate and heterogeneous in metrical poetry; and, *vice versa*, whether in the language of a serious poem there may not be an arrangement both of words and sentences, and a use and selection of . . . figures of speech . . . which on a subject of equal weight would be vicious and alien in correct and manly prose. I contend, that in both cases this unfitness of each for the place of the other frequently will and ought to exist.[59]

And, in support, he presents five reasons. First, from the origin of metre. Metre arises in the attempt of the mind to check the spontaneous expression of passion. Hence, there results a union "of spontaneous impulse and voluntary purpose," which "can be manifested only in a frequency of forms and figures of speech." "It not only dictates but of itself tends to produce a more frequent employment of picturesque and vivifying language than would be natural in any other case." He assumes that Wordsworth objected to the use of figures of speech in poetry; the latter, however, does not reject them utterly, but uses them sparingly.[60]

Second, from the effects of metre. Coleridge argues that metre

tends to increase the vivacity and susceptibility both of the general feelings and of the attention. . . . Metre resembles . . . yeast . . . [by] giving vivacity and spirit to the liquor with which it is proportionally combined.

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[57] *Biog. Lit.*, p. 190. [58] *Ibid.*, Chap. XVIII, p. 191.
[59] *Ibid.*, p. 195.
[60] The Preface of 1800, in Alden, *op. cit.*, pp. 6–7.

And then comes the keystone:

I write in metre, because I am about to use a language different from that of prose. Besides, where the language is not such how interesting soever the reflections are that are capable of being drawn by a philosophic mind from the thoughts or incidents of the poem the metre must often become feeble.[61]

In support of this reason he quotes several stanzas from *The Sailor's Mother*. The second stanza he approves of:

> The ancient spirit is not dead;
> Old times, thought I, are breathing there;
> Proud was I that my country bred
> Such strength, a dignity so fair:
> She begged an alms, like one in poor estate;
> I looked at her again, nor did my pride abate.

But the next quotation he disapproves of, except that it is "the only fair instance that I have been able to discover of the *real and very language of low and rustic life*, freed from provincialisms."

> And, thus continuing, she said,
> "I had a Son, who many a day
> Sailed on the seas; but he is dead;
> In Denmark he was cast away;
> And I have travelled far as Hull to see
> What clothes he might have left, or other property."

Does the metre justify these lines being written metrically? he asks.[62] We must admit that the scansion is weak; but is it so because of the diction? May there not be some other reason, such as the failure to imbue the subject with emotion, or to reflect on it, or even to give proper attention to the selection of the details that make up the situation? Wordsworth errs oftener, perhaps, in the choice of artistic selection than in the choice of diction.

Third and fourth:

The very act of poetic composition . . . produces an usual state of excitement, which . . . justifies and demands a correspondent difference of language.

Fifth:

The practice of the best poets shows that there may be, is, and ought to be an *essential* difference between the language of prose and of metrical composition.[63]

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[61] *Biog. Lit.*, Chap. XVIII, pp. 197–199.
[62] *Ibid.*, pp. 199–200. See Alden, *op. cit.*, pp. 130–131. [63] *Ibid.*, p. 201.

Of passages of poor verse, such as Daniel's *The Civil Wars*, he writes,

> [Though] the sense shall be good and weighty, the language correct and dignified, the subject interesting and treated with feeling . . . yet the style shall, notwithstanding all these merits, be justly blamable as prosaic, and solely because the words and the order of the words would find their appropriate place in prose, but are not suitable to metrical composition.[64]

This is from Chapter XVIII of the *Biographia Literaria*, in which he also writes, what seems irreconcilable, "that there are sentences which would be equally in their place both in verse and prose." [65] Also, in Chapter XVI, he says:

> A poem contains the same elements as a prose composition, the difference therefore must consist in a different combination of them, in consequence of a different object being proposed. According to the difference of the object will be the difference of the combination. . . . If metre be superadded, all other parts must be made consonant with it.[66]

He does not say what the "elements" are. Are they "words" or "the order of the words" or both?

From the foregoing exposition, then, Coleridge's view is that prose and verse have each their separate language. When a poet writes in verse, he chooses a diction and an order of words different from those in prose. In this he is in disagreement with Wordsworth — at least in theory; provided always that we remember the confusion of words. Moreover, Coleridge emphasizes mere choice of diction, as his suggested revisions of a number of Wordsworth's and his own poems show. But with Wordsworth it is a question of feeling or emotion and of the language arising spontaneously out of it and appropriate to it; the diction is the very fiber of the imaginative moment and not a cold choice of this or that word.

There is disagreement between them, also, on the origins of the best part of language.[67] Coleridge did not understand the drift of Wordsworth's discussion on this point. He thought it was all simple; but its basis is Wordsworth's mysticism. Wordsworth's origin arises in his attempt to capture and express the mystical in nature and in man and the fundamental relationship of the two.

[64] *Biog. Lit.*, Chap. XVIII, p. 204.
[65] *Ibid.*, p. 202.
[66] *Ibid.*, pp. 163–164.
[67] See above, pp. 552–553.

The rustic, because he "hourly communicates" with, that is, lives close to, nature, Wordsworth felt was better able to supply him with a suitable and adequate language than the social or political or "moral" man, whose language is the origin for Coleridge. By extension, this difference becomes marked: the one finds the best part of language in the names of objects, the other in abstractions and generalizations.[68]

While they further differed in their definitions, I feel that they were fundamentally at one in opposing a gaudy and false diction with "the language of nature and of good sense." Had Wordsworth been surer of what he meant; had he, for instance, used the word "natural" rather than "real"; had the terms of the theory meant the same to both, I think Coleridge would have moderated his opposition.

Though I have great respect for Coleridge's intellect, I feel sometimes that Wordsworth is more correct, that he was not in error in trying to return poetry to its original source, that is, the soil of nature. He got at his notion intuitively, but had difficulty in putting it understandingly.

IV

There is not much for our purpose in De Quincey's essays *Style* and *Rhetoric*, nor in *The English Language*. In *Style* he reports having heard Mr. Wordsworth deliver "by far the weightiest thing [he] ever heard on the subject of style": "That it is in the highest degree unphilosophic to call language or diction 'the dress of thoughts.'" Mr. Wordsworth "would call it 'the *incarnation* of thoughts.'" Wordsworth, De Quincey says, "was thinking, doubtless, of poetry like his own; viz. that which is . . . meditative."[69] This merely means, of course, that one cannot separate language and thought. The implication of this theory is that instead of criticizing or discussing a poet's diction, we ought to confine ourselves to his thought or feeling, for whenever his thought is paltry his language will be accordingly.

[68] For this and the preceding paragraph I am indebted to Raleigh, *op. cit.*, pp. 93, 112, 121, 124–133, 172–176, 183–184.

[69] *Historical and Critical Essays* (Ticknor, Reed, and Fields, 1853), 2 : 186.

In the essay *On Wordsworth's Poetry* we get De Quincey's theory of the diction of poetry. In the Postscript to it in 1857 he complains that Wordsworth was so filled with "*sacred* laziness," "excess of inertia," that during fifty years he never elaborated upon his theory or exemplified it with "a crop of five thousand further cases." Wordsworth had "an entire misconception of his own meaning." [70] In commenting upon *The Excursion* De Quincey finds "the colloquial form which the poem sometimes assumes" a defect, and lays down the rule that the diction of a philosophical poem should not be colloquial: "It is dangerous to conduct a philosophic discussion by talking." [71]

Wordsworth's theory, he says, is "not true in a double way." Wordsworth did not mean that the very language of men "was the proper diction for poetry, . . . for only a part . . ., according to his own subsequent restriction, was available . . . and . . . as his own subsequent practice showed, . . . this part was available only for peculiar classes of poetry." [72] In *Laodamia*, in the sonnets, and in *The Excursion*, "few are his obligations to the idiomatic language of life." And then he repeats Coleridge's observations that there are dictionary words in *The Excursion*, implying that the ordinary language of men is devoid of these or polysyllabic words of foreign origin.[73]

His word on diction is this:

> The gamut of ideas needs a corresponding gamut of expressions; the scale of the thinking which ranges through every key exacts, for the artist, an unlimited command over the entire scale of the instrument which he employs.

This can mean that every word in the language is available for poetic purposes. It can mean, also, that for certain ideas there will be a certain language, depending on whether we emphasize particularly diction or language.

Both Saxon and Latin words "are equally indispensable." In expressions of "pathos," "lyrical emotion," "the elementary situations of life," Saxon will predominate. "Wherever the

[70] Masson edition, 11 : 325. [71] *Ibid.*, p. 313.

[72] In this he seems to be imitating Coleridge, *Biog. Lit.*, Chap. XVII, p. 180.

[73] In *Biog. Lit.*, Chap. XX, p. 223.

passion of a poem is of that sort which *uses, presumes,* or *postulates* the ideas, without seeking to extend them, Saxon will be the 'cocoon' which the poem spins for itself." But, "where the motion of the feeling is *by* and *through* the ideas, where . . . the sentiment creeps and kindles underneath the very tissues of the thinking . . . there the Latin will predominate." [74]

If I interpret De Quincey correctly, the whole of the language is at the disposal of the poet. No single word should be denied him. Dr. Wilson objected to Wordsworth's use of "idiot" and perhaps Wordsworth did err in using it in his context.[75] But Shakespeare used it to good effect and not incongruously:

> It is a tale
> Told by an *idiot,* full of sound and fury,
> Signifying nothing.

Even the diction of modern life may be used to advantage, as Robert Bridges has used it:

> My neighbor's foolery were worse,
> Sat he agape listening to Mozart, intently desiring
> All that time to be rattling along on a furious engine
> In caouchouc carapace, with a trail of damnable oilstench.[76]

To reiterate, but this time in the language of Professor Lowes:

> Words . . . become poetic, or they remain unassimilated prose, according as the poet's imaginative energy is or is not sufficiently powerful to absorb them.

Some words are more readily assimilable than others, for example those "which are associated with *objects* that stir the sort of emotion which is the basis of poetry — with the immemorial, universal phenomena of soul and sense." [77]

V

To come now to the moderns, in the latter half of the nineteenth century, poets forgot the principle of Wordsworth and wrote in the rhetoric and the "poetic" diction to which he was opposed.

[74] "On Wordsworth's Poetry," in Alden, *op. cit.,* pp. 329–330.

[75] Wordsworth's Letter to John Wilson, 1802, *Prose Works* (Knight ed.), 1 : 41.

[76] *To a Socialist in London,* ll. 290–294. [77] J. L. Lowes, *op. cit.,* p. 193.

Tennyson and Browning seem literary. "Technique usurped the place of emotion, and words, mere words, were exalted out of all due proportion." [78] This is especially so with Swinburne, with whom poetry often is only sound and fury, signifying nothing. "The truly modern poet," write Monroe and Henderson, "rejects the so-called 'poetic' shifts of language — the *deems*, *'neaths*, *forsooths*, etc., the inversions and high-sounding rotundities familiar to his predecessors: all the rhetorical excesses through which most Victorian poetry now seems 'over-apparalled.'" [79] William Butler Yeats and his companions of the Celtic renaissance, as he said in Chicago, "wanted to get rid not only of rhetoric but of poetic diction. [They] tried to strip away everything that was artificial, to get a style like speech, as simple as the simplest prose, like a cry from the heart." [80]

There is a return, then, in present practice, to the theory of 1800. There is a turning to "the language of contemporary speech," [81] which in Carl Sandburg goes so far as to include the slang and the solecisms of the street. Louis Untermeyer writes:

> Our poets are coming back to the oldest and most stirring tongue; they are using a language that is the language of the people. Nor is this a mere revolt from the stilted and aestheticized speech that was the expression of a narrowed and aestheticized vision of life. They have rediscovered the beauty, the dignity, I might almost say the divine core, of the casual and the commonplace. They are bringing to ordinary speech a new affection and interest, calling forth its natural warmth, its original power.[82]

Whitman is the forerunner of this present movement. He loved the colloquial and the racy. His strength lay in using the language "that flowered in the street rather than in libraries." [83] His poems grew out of the common ordinary life and language of the people, the demos.

Robert Frost is perhaps the best contemporary counterpart of Wordsworth. Amy Lowell finds his secret "in his accurate observation, coupled with a perfect simplicity of phrase:

[78] Amy Lowell, *Tendencies in Modern American Poetry*, p. 5.
[79] *The New Poetry*, Introduction, p. v.
[80] *Ibid.*, p. ix.
[81] *Ibid.*, p. vi.
[82] Louis Untermeyer, *The New Era in American Poetry*, p. 11.
[83] *Ibid.*, p. 12.

> He tells us what he has seen exactly as he has seen it. He is never seduced into subtleties of expression which would be painfully out of place. His words are simple, straightforward, direct, manly, and there is an elemental quality in all that he does which would surely be lost if he chose to pursue niceties of expression.

And then she quotes Edward Garnett's praise of Frost's style: "extraordinarily close to normal everyday speech." [84]

The chief practitioners of this "new" poetry are Americans, so that we seem in a fair way to accomplish Whitman's hope for "the Americans . . . to become the most fluent and melodious-voiced people in the world — the most perfect users of words." [85] But I do not find that such writers as Edwin Arlington Robinson, Robert Frost, Edgar Lee Masters, Carl Sandburg, Vachel Lindsay have concerned themselves much with the statement of a theory. They have left this for editors, who deduce the theory from the practice.

This is not so, however, of those poets who are grouped under the banner of Imagism. They speak for themselves. The spokesman is Ezra Pound, and H. D. and Richard Aldington sit on the platform with him. They have their creed, from which I shall quote only those rules which concern the matter of diction.[86]

> No. 1. To use the language of common speech, but to employ always the *exact* word, not the nearly-exact, not the merely decorative word.

This excludes inversions and *clichés*. The *exact* word "means the exact word which conveys the writer's impression to the reader. . . . To the poet the thing is as it appears in relation to the whole." [87] Wordsworth wrote in the *Essay Supplementary to the Preface of 1815* something to the same effect:

> The appropriate business of Poetry . . . is to treat of things not as they *are*, but as they *appear*: not as they exist in themselves, but as they *seem* to exist to the *senses*, and to the *passions*.[88]

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[84] Amy Lowell, *op. cit.*, pp. 128–129. A good example from Frost is *Mending Wall*.

[85] L. Untermeyer, *op. cit.*, p. 12, quoted.

[86] I quote from Amy Lowell, *op. cit.*, pp. 239–249.

[87] Amy Lowell, *op. cit.*, p. 242.

[88] *Prose Works* (Knight ed.), 2 : 226.

This idea of exactness to the impression has led the critics to call the imagists impressionists. Further, Ezra Pound has this to say:

No word is ever chosen merely for the tinkle; each has always its part in producing an impression which is produced always through language.[89]

No. 4. To present an image (hence the name: "Imagist"). We are not a school of painters, but we believe that poetry should render particulars exactly and not deal in vague generalities, however magnificent and sonorous.

This rule is not "concerned with the presentation of pictures." It refers more to the "manner of presentation than to the thing presented." Hence, imagism means a "clear presentation of whatever the author wishes to convey." It is "presentation [of a mood, and impression, perhaps], not representation." [90]

No. 5. To produce poetry that is hard and clear, never blurred nor indefinite.

No. 6. Finally, most of us believe that concentration is of the essence of poetry.

Rule 5 refers to the way in which the subject is rendered, not to the subject. Imagist diction does not avoid metaphorical language, but uses similes sparingly. Rule 6 is obvious.

In an article called "A Consideration of American Poetry," [91] Miss Lowell has elaborated on the dicta of this creed. I append a brief extract from it.

"The idiom . . . in which 'modern' poetry may be said to be written, has for its elements: Suggestion, Vividness, Concentration, and Externality."

On Suggestion. — "To the poet, the thing is as it suggests itself in relation to the whole, and the 'exact' word is the one which best renders this suggestion."

On Vividness. — "To state a thing . . . is not enough; it must impose itself upon the mind's eye in an inescapable picture." The "dramatic" way of expression is preferable.

On Concentration. — This demands "faithfulness to the architectural line," the "discarding of all extraneous detail which tends to blur or diminish the vividness of the main theme."

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[89] *Ezra Pound, His Metric and Poetry*, p. 14.

[90] Quoted by Amy Lowell, *op. cit.*, pp. 244–245, from *Some Imagist Poets*, 1916. This idea has caused much criticism; see Bruce Weirick, *From Whitman to Sandburg in American Poetry* (1924), pp. 164–165.

[91] *North American Review*, 205 (1917) : 103–117, especially 105–106.

On Externality. — This "concerns itself with man in his proper relation to the universe, rather than as the lord and master of it." Hence, there is no pathetic fallacy.

Ezra Pound's "Don't's" for imagists are illuminating:

Use no superfluous word and no adjective which does not reveal something.

Don't use such an expression as "Dim lands of *peace*." It dulls the image. It mixes an abstraction with the concrete. It comes from the writer's not realizing that the natural object is always the *adequate* symbol.

Go in fear of abstractions.

Don't be "viewy" — leave that to the writers of pretty little philosophic essays. Don't be descriptive; remember that the painter can describe a landscape much better than you can. . . .

Consider the way of the scientists rather than the way of an advertising agent for a new soap.

Don't mess up the perception of one sense by trying to define it in terms of another. This is usually only the result of being too lazy to find the exact word.

Consider the definiteness of Dante's presentation as compared with Milton's. Read as much of Wordsworth as does not seem too unutterably dull.[92]

Besides a return to Wordsworth and Dante he suggests a return to Latin and Greek poets, especially to Catullus and Sappho. This also seems to be the practice of H. D. and Richard Aldington. And the *Spoon River Anthology* owes something to the *Greek Anthology*.[93] We thus come back to Wordsworth, both in theory and in practice.

VI

We can now sum up. Goldsmith suggested the idea that a natural language is suitable to poetry, but he was still so held by the conventional diction of his day that he could not see the full implication of his discovery. Wordsworth took it and in boldness formulated it into a theory, albeit somewhat faultily, and has reaped whatever praise or blame the world has bestowed. Coleridge disclaimed it and opposed it; that is, Wordsworth's theory, chiefly, I think, because it was uncertain in its meaning; but he both practiced it and praised the application of it in the work of others. De Quincey seems to discern a distinction between

[92] From *Ezra Pound, His Metric and Poetry* (1917), p. 20; and Ezra Pound, "A Few Don'ts by an Imagiste," *Poetry*, 1 (1913) : 200–206.

[93] Amy Lowell, *op. cit.*, p. 182.

language and diction, and to find that every idea (and feeling) has its own peculiar expression.[94] He may be said to agree with both Wordsworth and Coleridge. Our contemporaries go back to Wordsworth, though they are more exact when they write of their theory. They go to the language of the people — the high and the low, the sophisticated and the rustic — and to the exact word, to the truth of the impression the objective world makes on the mind of the poet.

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[94] Cf. J. L. Lowes, *op. cit.*, p. 185, and R. Bridges, *Poetic Diction in English*, No. III of *Collected Essays, Papers . . .*, Oxford, 1928.

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SOME NOTES ON THE DIFFERENTIAE OF PROSE AND POETRY, WITH SPECIAL REFERENCE TO THE THEORY OF COLERIDGE

CLARENCE D. THORPE

I HAVE lately begun to suspect that I am learning to understand a little better the essential differences between prose and poetry.[1] It is, I know well enough, a risky business to try to make oneself understood on this subject; and it would obviously be the better part of discretion to refuse to venture where greater ones have found themselves in trouble. Consider, for instance, the difficulties of Wordsworth and Coleridge on the question of poetic form. In their days of greatest intimacy the two poets had arrived at what both confidently believed to be an agreed basis for poetry, but later Coleridge, especially, came to feel that their views were not in harmony. This is a fact rather well known; it is made particularly clear in a letter to Sotheby,[2] in which Coleridge relates the genesis of the ideas Wordsworth was supposed to have expressed in his Preface. The letter represents an earlier stage in Coleridge's distrust of Wordsworth's statements, the expression of which becomes more unmistakable in the *Biographia Literaria*. He here *feels*, rather than understands, the difference in their theories:

> I must set you right with regard to my perfect coincidence with his [Wordsworth's] poetic creed. . . . In my opinion, every phrase, every metaphor,

[1] For purposes of this discussion I shall use the words "poetry" and "verse" as opposed to "prose," interchangeably, ignoring the frequent larger and more indefinite application of the term "poetry" to almost any artistic language form.

[2] *Letters of Samuel Taylor Coleridge*, edited by Ernest Hartley Coleridge (Heinemann, London, 1895) 1: 374. Hereafter, I shall refer to this publication as "Letters."

every personification should have its justifying clause in some passion, that is, a state of excitement both in the poet's mind and is expected (*sic*) in part, of the reader; and, though I stated this to Wordsworth, and he has in some sort stated it in his preface, yet he has not done justice to it nor has he, in my opinion, sufficiently answered it. In my opinion, poetry justifies as poetry, independent of any passion, some new combinations of language and commands the omission of many others allowable in other compositions. Now Wordsworth *me saltem judice*, has in his system not sufficiently admitted the former, and in his practice has too frequently sinned against the latter. Indeed we have had lately some little controversy on the subject, and we begin to suspect that there is somewhere or other a radical difference in our opinions.

I shall return to this letter later, but I leave it for the time as a bit of remarkable evidence upon the subtlety which envelops and must envelop any discussion of distinction between prose and poetry.

Attempts to define poetry have, in the past, followed many and varied lines. Poetry has been said to have distinct formal qualities. Professor J. M. Mackail holds that the unique thing in poetry is "patterned language." [3] "Poetry," says Carlyle, is "musical Thought." [4] Here belong all those definitions which emphasize metre, rhyme, alliterative and tonal effects, cadence and like structural elements.

The problem of a valid subject-matter for poetry was a continual preoccupation of medieval and Renaissance critics. It has by no means become a dead issue. "Pure poetry," according to George Moore, deals with things and not ideas.[5] Poetry is a "criticism of life," says Arnold.[6]

From the point of view of the writer, poetry is said to have a different purpose from prose: "Poetry," explains Dr. Fred Newton Scott, "is communication in language for expression's sake; prose is expression in language for communication's sake." [7] This implies an opposition between poetry and prose analagous to that

[3] *Lectures on Poetry*, 1911. The phrase occurs frequently, chiefly in the essay "The Definition of Poetry."

[4] "The Hero as Poet," in *Heroes and Hero Worship*.

[5] *Anthology of Pure Poetry*. Introduction.

[6] The phrase first occurred in Arnold's essay on Joubert, where it is applied to "literature." Later, it appeared in *On Translating Homer* and in *The Study of Poetry*, with special application to "poetry."

[7] "The Most Fundamental Differentia of Poetry and Prose," *The Standard of American Speech*, p. 246.

existing, in general, between the utilitarian and the artistic, between the desire to be practical and the desire to please.

Poetry has a unique mission; it exists to reveal and to illuminate life. "Poetry lifts the veil from the hidden beauty of the world, and makes familiar objects be as if they were not familiar." [8]

The mode of appeal of poetry is different: "Poetry," says Abbé Bremond, in effect, "is the direct transfer of a mystical-like experience without the intermediary of reasoned idea." [9]

The effect of poetry differs from that of prose. "Beauty," Poe explains, consists in "that intense and pure elevation of *soul* — *not* of intellect, or of heart . . . which is experienced in consequence of contemplating 'the beautiful.'" [10]

Referable to some one, at times to two or more, of the differentiae expressed in the foregoing, are such varied definitions as I. A. Richard's terse "Poetry is an experience"; [11] Emerson's "Poetry is the perpetual endeavor to express the spirit of the thing, to pass the brute body, and search the life of reason which causes it to exist"; [12] and those parts of Shelley's delimitations in which he touches upon matters other than mode and effect, as "A poem is the very image of life expressed in its eternal truth . . . [it] is a creation of actions according to the unchangeable forms of human nature, which is itself the image of all other minds. . . . Poetry redeems from decay the visitation of the divinity of man." [13] J. M. Murry's definition of "pure poetry" inclines strongly toward subject-matter as the differentiating element in poetry, but it is also inclusive of the mode. With Mr. Murry, "pure poetry consists in the power so to express a perception that it appears at the same time to reveal a new aspect of beauty and a new aspect of truth." [14] This does not mean that "poetry which contains the greatest amount of explicit and recognizable thought is the pro-

[8] Shelley's *Defense of Poetry.*

[9] As presented in *The Quintessence of Poetry*, a paper read by Professor V. Guilloton, at the 1925 meeting of the Modern Language Association, Cambridge. M. Bremond's idea was first published in a lecture on "Pure Poetry" before the French Academy, and was later elaborated in his *Prayer and Poetry* (translated by Algar Tharold), 1927.

[10] *Philosophy of Composition.*

[11] *Principles of Literary Criticism*, pp. 78, 226.

[12] "Poetry and Imagination," in *Letters and Social Aims.*

[13] *Defense of Poetry.*

[14] *Keats and Shakespeare* (1925), pp. 10–11.

foundest poetry," but that there is in this world "a final *human* truth," and pure poetry expresses "a perception of this truth." "Pure poetry . . . is revealed to us as the natural utterance of the finest and completest living. It is no longer a bewildering accident or a troublesome excrescence in a rational scheme of things. It is the most perfect flower on the tree of life." Poe's complete definition of poetry has reference to both form and effect, and does not at all neglect content, as it is sometimes contended. One wants to produce an impression of melancholy: "Of all melancholy topics what . . . is the *most* melancholy? Death." And when is this most melancholy topic most poetical? Obviously when most closely allied with beauty — "the death, then, of a beautiful woman is, unquestionably, the most poetical topic in the world. . . ." [15]

For purposes of arriving at precise differentiae of prose and poetry definitions are not satisfying. They are likely to be very general, or merely descriptive, and actually do little to limit their subject; moreover, what is said is usually not peculiar to poetry as a form, but might be equally applicable to prose, often, indeed, to all art whatever.[16] If a poem is "an experience," so is a fine painting, and a sonata, and a piece of sculpture. If Shelley's lyrics and Shakespeare's dramas do indeed lift the veil from the hidden beauty of the world, and make familiar objects be as if they were not familiar, so likewise do Thackeray's and Tolstoy's novels and Katherine Mansfield's and Chekhov's stories; if there is direct appeal and emotional elevation in Poe's *Raven*, if there is illumination in Browning's *Ring and the Book*, so is there thrill in Dumas' *The Three Musketeers* and Scott's *Ivanhoe*, illumination in Hardy's *Tess of the D'Urbervilles*, in Dostoievski's *The Idiot*, in Hamsun's *Growth of the Soil*, and in Proust's *Swann's Way*.[17]

In the presence of such facts, many critics have fallen back on

[15] *Philosophy of Composition.*

[16] The "definitions" I have cited, it is true, do scant justice to the authors quoted; they are in each case but fragments of more complete discussions.

[17] Read George Eliot's account of the effects upon her impressionable mind of Rousseau's prose *Confessions*. Before her days of authorship (1849) a friend expressed surprise at Eliot's delight in the *Confessions*. "I wish you to understand," she replied in self-defense, "that the writers who have most

the simple expedient of making rhythmic quality the single distinguishing mark of poetry, as does A. R. Symons in *The Romantic Movement in English Poetry*. "Coleridge," he writes in his opening sentence, "defined prose as 'words in good order,' poetry as 'the best words in the best order.' But there is no reason why prose should not be the best words in the best order. Rhythm alone, and rhythm of a regular and recurrent kind only, distinguishes poetry from prose." And, answering Courthope's contention that poets dare, because of form, to say things of an ecstatic kind which prose writers will not venture, he holds that prose can say anything that poetry can; "the rhythm alone transforms it into poetry, and nothing but the rhythm."

But a recognition of rhythmic differences alone does not satisfy one's demand for analytical description of essential differentiae any more than does any one of the several definitions already quoted in this paper. Coleridge comes nearer to it in his single remark to the effect that the use of certain words in a certain order shows that the speaker has "a song in his head," [18] or in his explanation of poetry as originating in a state of strong mental excitement, and as taking a form in harmony with the emotions which produced it. Poetry is the natural language of passion and emotion.[19] In fact, no one has written more comprehensively

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profoundly interested me — who have rolled away the waters from their bed, raised new mountains and spread delicious valleys for me — are not in the least oracles to me. It is just possible that I may not embrace one of their opinions — that I may wish my life to be shaped quite differently from theirs. For instance it would signify nothing to me if a very wise person were to stun me with proofs that Rousseau's views of life, religion, and government are miserably erroneous. . . . I might admit all this, and it would be not the less true that Rousseau's genius has sent that electric thrill through my intellectual and moral frame which has awakened me to new perceptions — which has made man and nature a world of freer thought and feeling to me; and this not by teaching me any new belief. It is simply that the rushing mighty wind of his inspiration has so quickened my faculties that I have been able to shape more definitely for myself ideas which had previously dwelt as dim *Ahnungen* in my soul" (Lord Morley, *Recollections*, p. 90).

[18] *Biographia Literaria*, Chap. XVI; Shawcross, 2 : 58. All references to the *Biographia Literaria* are to the Shawcross edition.

[19] *Ibid.*, Chap. XVIII; 2 : 50. Also *On Poesy or Art;* Shawcross, 2 : 254, and "The Wonderfulness of Prose," *The Complete Works of Samuel Taylor Coleridge*, Shedd, 4 : 388. Hereafter, I shall refer to this latter work as "Shedd.'

and rewardingly on the subject of the differences between prose and poetry than has Coleridge. There are certain apparent inconsistencies in what he has to say, but, after making all allowance for these, there remains a body of statement and argument which under scrutiny steadily focuses to illuminating unity of conclusion.

Coleridge believed firmly that there is a division between prose and poetry which all good literary artists observe.[20] "Lastly," he writes, at the close of his argument for distinctions in Chapter XVIII of the *Biographia*, "I appeal to the practice of the best poets, of all countries and in all ages, as *authorizing* the opinion . . . that in every import of the word ESSENTIAL . . . there may be, is, and ought to be an *essential* difference between the language of prose and of metrical composition." [21] And again he insists: "The 'true poet' will never confound verse and prose; whereas it is almost characteristic of indifferent prose writers that they should be constantly slipping into scraps of metre." [22] Coleridge here not only states his disapproval of mixed forms, either prose in verse or poetical prose, which he elsewhere calls a "very vile Olio," [23] but implies, for the gifted at least, readily distinguishable differentiae of prose and verse.

In dealing with Coleridge's ideas on this subject, it is well to remember that, like Aristotle and Longinus — like all great critics in fact — he was a psychologist; probably, one is tempted to add, the greatest psychologist of them all. To Coleridge, there existed an inseparable relationship between the fundamental inner states and processes of the artist and the manner of his expression. With him the organic form manifested in any given work of art exists as a direct result of an organic form developed within the mind. "Perfection of outward form is a symbol of the perfection of an inward idea."

[20] An exception might be adduced from such discussions as occur in Chapters XIX and XX of the *Biographia*, where Coleridge deals with the "neutral style," but the selections from Chaucer and Herbert used to illustrate his point are anything but prosaic; they contain indeed most of the marks of poetry he elsewhere insists upon.

[21] *Biog. Lit.*, Chap. XVIII; 2 : 56, 57. The italics are Coleridge's own; he uses italicized expression on every occasion.

[22] "On Style"; Shedd, 4 : 342. [23] *Letters*, 1 : 378.

Accordingly, in terms of our present discussion, prose becomes prose, or poetry becomes poetry, in obedience to inner mental states which mold the language into forms which best express or communicate that particular attitude of mind. "This I may say," writes Coleridge apropos the point,[24] "that poetry, as distinguished from other modes of composition, does not rest in meter, and that it is not poetry if it makes no appeal to our passions or our imagination. One character belongs to all true poets, that they write from a principle within, not originating in anything without, and that the true poet's work in its form, its shapings, and its modifications, is distinguished from all other works that assume to belong to the class of poetry, as a natural from an artificial flower, or as the mimic garden of a child from an enamelled meadow." [25]

Poetry, then, comes into existence, as we know it in the objective symbols of language, as a result of poetry in the mind of the writer or speaker. Coleridge stated this idea in its simplicity when he pointed out that one writes in the poetic form because he has a song in his head:

> Should the sportsman exclaim, "Come boys! the rosy morning calls you up," he will be supposed to have some song in his head. But no one suspects this when he says, "A wet morning shall not confine us to our beds." [26]

Something of the poet-critic's notions on this subject of music is pictorially expressed in the following contrast between the poetic and the metaphysical:

> I wished to force myself out of metaphysical trains of thought, which, when I wished to write a poem, beat up game of far other kind. Instead of a covey of poetic partridges and with whirring wings of music, or wild ducks *shaping* their rapid flight in forms always regular (a still better image of verse), up came a metaphysical bustard, urging its slow, heavy, laborious, earth-skimming flight over dreary and level wastes.[27]

More frequently he insists on mental excitement or passion, rather than song, as the originating impulse to poetry:

> Our language gives to expression a certain measure, and will, in a strong state of passion, admit of scansion from the very mouth. The very assump-

[24] Shedd, 4: 57.

[25] It was possibly something like this that Keats meant when he remarked that "poetry should come as naturally as the leaves of a tree."

[26] *Biog. Lit.*, Chap. XVIII; 2: 58. [27] *Letters*, 1: 378.

tion that we are reading the work of a poet supposes that he is in a continuous state of excitement; and thereby arises a language in prose unnatural, but in poetry natural.[28]

Poetry is the natural language of passion and emotion, Coleridge explains. Savages were used to poetry before they knew prose: "it is what they themselves spoke and heard in moments of exultation, indignation, &." [29] And in the *Biographia* occurs a justification, on the ground of passion, of the repeat in Biblical and free verse:

> Nothing assuredly can differ either in origin or in mode more widely from the apparent tautologies of intense and turbulent feeling, in which the passion is greater and of longer endurance than to be exhausted or satisfied by a single representation of the image or incident exciting it. Such repetitions I admit to be beauty of the highest kind; as illustrated by Mr. Wordsworth himself from the song of Deborah. *At her feet he bowed, he fell, he lay down; at her feet he bowed, he fell; where he bowed, there he fell down dead.*

Over and over, Coleridge reaffirms the belief that *passion*, which he defines "in its general sense as an excited state of feelings and faculties," [30] is the true basis of poetry. "And as every passion has its proper pulse, so will it likewise have its characteristic modes of expression." [31] The language of passion falls naturally into poetic form.[32]

Coleridge's accounts of his own practice, particularly in the composition of *Kubla Khan*, might be added to the statements quoted in the preceding paragraphs to prove a doctrine of organic inevitability almost independent of volition. And his frequent emphasis upon spontaneity in poetic composition may be used to strengthen the case. Take, for instance, the following modification of Milton's definition of poetry as "simple, sensuous and passionate":

> " . . . this most general and distinctive character of a poem originates in the poetic genius itself . . . which sustains and modifies the emotions,

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[28] *Seven Lectures on Shakespeare and Milton*, edited by Collier, P., p. 18. Hereafter, this work is referred to in this paper as "Collier."

[29] *The Wonderfulness of Prose*, Shedd, 4 : 388.

[30] *Biog. Lit.*, Chap. XVIII; 2 : 56. [31] *Ibid.*

[32] Cf. Carlyle's idea: "It is a man's sincerity and depth of vision that makes him a poet. See deep enough and you see musically; the heart of Nature being everywhere music, if you can only reach it." — *The Hero as Poet.*

thoughts, and vivid representations of the poem by the energy without effort of the poet's own mind, — by the spontaneous activity of his imagination and fancy, and by whatever else with these reveals itself in the balancing and reconciling of opposite or discordant qualities. . . ." [33]

Again, speaking in the praise of the madrigals of Giovambatista Strozzi, he says, relevant to this point, "Trifles as they are, they were probably elaborated with great care; yet in the perusal we refer them to a spontaneous energy rather than to a voluntary effort." [34]

Such objection as Coleridge had to Wordsworth's poetic creed and practice (so far as this difference was real rather than fancied) may be traced, I suspect, to this fundamental insistence by Coleridge on the principle of organic expression.[35] A deliberately

[33] Shedd, 4:21.

[34] *Biog. Lit.*, Chap. XVII; 2:25.

[35] A careful study of Wordsworth's Preface, and especially the Appendix to the Preface (1802), in connection with Coleridge's own comments on poetic form, shows that there was much less actual difference in the views of the two poets than certain passages in Coleridge's attack would seem to indicate. Coleridge was alarmed by Wordsworth's phrase, "language really used by men," particularly because of its, perhaps unfortunate, juxtaposition to the eulogium on rustic life and to remarks upon the dignity and "philosophical" superiority of the language used by the rustic; and in his anxiety to disavow his adherence to such heresy, he rather lost sight of Wordsworth's real emphasis. Wordsworth actually says a "*selection* of language really used by men," and when he points out the merits of the language of common life, he is praising, not its rudeness nor its dialectical peculiarities, but rather its natural, direct, inartificial quality as opposed to the "arbitrary and capricious" inventions of the "school" poets. Wordsworth in no sense commits himself to employment of the dialect of the farmer. His intent is to disparage the overrefinement of an artificial poetic diction, the "distorted language" of Marinism and of preciosity, "the wanton deviation from good sense and nature" of practitioners of the conceit and other forms of "adulterated phraseology"; his quarrel is with those who had introduced a language which had become "daily more and more corrupt, thrusting out of sight the plain humanities of nature by a motley masquerade of tricks, quaintnesses, hieroglyphics, and enigmas." Like most ardent arguers Wordsworth exaggerated in order to enforce his point — exaggerated in both directions, making the language of the rustic a bit more dignified and attractive, the language of professional poets a bit more meretricious than reality justified. But when we read passages like Crashaw's description of the Magdalene's eyes as

> "Walking baths and weeping motions,
> Copious and compendious oceans,"

superimposed language, either that of the common man or of anyone else, could not contribute to poetry; moreover, if the language in a so-called poem failed to show evidence of a song, or of an adequate passion (or state of excitement), in the poet's mind at the time of composition, the right condition for poetic creation could not have existed; hence there could be no true poem.[36] The proof of the pudding is in the eating. In a letter to Sotheby Coleridge admits joint responsibility for much of the Preface, but states positively, "yet I am far from going all lengths with Wordsworth." Evidence of failure of the theory in practice awakens his distrust of the theory itself:

> He has written lately a number of Poems . . . the greater number of these, to my feelings, very excellent compositions, but here and there a daring humbleness of language and versification, and a strict adherence to matter of fact, even to prolixity, that startled me. His alterations likewise in "Ruth" perplexed me, and I have thought and thought again, and have not had my doubts solved by Wordsworth. I suspect that there is a radical difference in our theoretical opinions respecting poetry.[37]

The suspicion that there must be fallacy in Wordsworth's creed obviously grew out of observed defects in poetry presumably con-

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or Francis Quarles' lines on an intemperate lady —

> "Her blistered tongue grows hot, her liver glows,
> Her veins do boil, her color comes and goes,
> She staggers, falls, and on the ground she lies
> Swells like a bladder, roars, and bursts, and dies,"

we know well enough what Wordsworth meant, and forgive the exaggeration. Coleridge, too, one feels, might well have recognized the purport of Wordsworth's argument; indeed, in light of the facts, some of his criticism seems highly captious. But this very exertion in criticism led to the brilliant and profound additions to his analysis of poetic form which occur in the *Biographia:* and for them we can overlook the grain of illiberality there revealed.

So far as organic expression was concerned, Wordsworth was quite as firm a believer in this principle as was Coleridge. Wordsworth's "spontaneous overflow of feeling," read in its full context in the Preface, as it always should be, is really descriptive of organic expression, as is, in essence, his whole argument for "natural" as opposed to "artificial" language. Here again Coleridge reasoned from the phrase rather than the context.

[36] It was Wordsworth's seeming emphasis upon mere *vocabulary* which aroused Coleridge to keenest opposition. But, as we have seen, this was but touching the surface of the real problem as Wordsworth saw it.

[37] July, 1802. *Letters*, 1 : 386, 387.

forming to that creed. If the application of a theory results in poetry which must be excluded from "the honors of unaffected warmth and elevation," must not that theory be wrong? [38] And from the letter to Sotheby, quoted on a preceding page, it is apparent that one element of Wordsworth's fallacy was his failure to hold strongly enough for a necessary correspondence between the mental state proper for poetry and its expression. Wordsworth did not, in other words, exemplify the principle of organic unity,[39] whereby the poetic genius operates through the spontaneous activity of the imagination and fancy toward ends dictated by its own "distinctive character."

In the Coleridge aesthetic, poetic creation requires not only spontaneity but effort of the will. The activity of the secondary, or artistic, imagination "coexists with the conscious will." [40] "Will" is a universal condition of beauty. Even "spontaneity is a function of living Will." [41] One writes in verse rather than prose through deliberate choice: "I write in metre because I am about to use a language different from that of prose," [42] Coleridge declares. Indeed, it seems rather clear that an exercise of volition is necessary to sustain for the requisite period of time the excitement of mind essential to poetic composition:

> Again, this union can be manifested only in a frequency of forms and figures of speech (originally the offspring of passion, but now adopted children of power) greater than would be desired or endured, where the emotion is not voluntarily encouraged and kept up for the sake of that pleasure, which such emotion, so tempered and mastered by the will, is found capable of communicating.[43]

In another passage Coleridge appears to imply that it is even possible to create through a deliberate act of volition the state of mind essential to poetic composition.

[38] *Biog. Lit.*, Chap. XVIII; 2:65.

[39] That Coleridge feels it is failure to recognize the necessity for this correspondence and not the proper mental state, appears in his statement: "Poetry, Mr. Wordsworth truly affirms, does always imply PASSION: which word must be here understood in its general sense, as an excited state of the feelings and faculties." — *Biog. Lit.*, Chap. XVIII; 2:56.

[40] *Biog. Lit.*, Chap. XIII; 1:202.

[41] *Fragments.* Ed. by T. M. Raysor. Modern Language Notes, 22:529.

[42] *Biog. Lit.*, Chap. XVIII; 2:53.

[43] *Ibid.*, Chap. XVIII; 2:50.

> But where there exists that degree of genius and talent which entitles a writer to aim at the honors of a poet, the very *act* of poetic composition itself is and is allowed to imply and to produce, an unusual state of excitement, which of course justifies and demands a correspondent difference of language, as truly, though not perhaps in as marked a degree, as the excitement of love, fear, rage, or jealousy.[44]

In other words, poetic composition once begun through an act of will is self-generative of the excitement which requires "a combination of words different from the language of prose." [45]

Good poetry implies not only volition, but good sense, restraint, judgment. In speaking of Shakespeare, Coleridge has the word "judgment" constantly on his lips. "But observe the matchless judgment of our Shakespeare," [46] he exclaims in reference to *King Lear*. And of the ghost scenes in *Hamlet:* "Note the judgment displayed." [47] "I have said, and I say it again that great as was the genius of Shakespeare, his judgment was at least equal to it." [48] Shakespeare, he says, "possessed the chief, if not every requisite of a poet, — deep feeling and exquisite sense of beauty, both as exhibited to the eye in the combinations of form, and to the ear in sweet and appropriate melody; moreover" — and this is the important point here — "these feelings were under the command of his own will"; [49] and being under the command of his own will, they were, one may infer, expressed according to the volition of the author.

Poetry as the natural language of song and of passion should be sharply distinguished, one might think, from poetry which owed its form to deliberate volition; yet a little reflection on the matter convinces one that sharp lines are hard to draw. Masefield decides to write his story in verse instead of prose. Does the fact that he has willed to write in a certain form, perhaps even a certain metre and stanza, rather than permitted himself to express natural passion and emotion in their own way, militate against his producing good poetry? If he has willed with wisdom, I doubt it. Indeed, could we imagine a poet writing in any other way than through a conscious effort of will? No matter how definite the subjective expression resulting from the operation of the creative

[44] *Biog. Lit.*, 2: 56. [45] *Ibid.* [46] Shedd, 4: 134.
[47] *Ibid.*, 4: 150. [48] *Ibid.*, 4: 59. [49] *Ibid.*, 4: 46.

— that is, the revealing and formative — imagination, the objective expression cannot be supposed to take care of itself. In the most spontaneous activity of the secondary imagination the Coleridge aesthetic would seem to presuppose a purpose, even where no purpose appeared evident.[50] But in the objectification of his experience, volition obviously becomes doubly essential. The poet's pen can scarcely be supposed to take unauthorized charge. There must be at least a choice of form, a selection from one of several possible plans. Consider Milton's varied outlines for his *Paradise Lost*.

One finds it hard to believe that most poetry is not begun as a result of a decision on the part of the author "to use a language different from the language of prose." Success, I judge, is dependent not so much on volition or lack of volition, as upon power of control in one's medium after the form is decided upon and the composition is begun. The poet wishes to produce a specific effect; he therefore adopts the means best fitted to achieve this effect. Control of effect can be secured only through control of stimuli. By throwing his thought into certain melodic patterns, or by selecting words fitted to arouse certain imagery and emotional response — exciting "vision by sound and the exponents of sound" through the employment of "*creative words* in the world of the imagination" [51] — the poet is able to arouse a desired tonal attitude, a certain mood of expectancy; and in the successfully completed poem he fulfils and satisfies this expectancy. Poetry owes much of its power to its capacity to establish such an enveloping feeling content, harmonious with the type of thing the writer wishes to express. Furthermore, because of its formal qualities, it provides a mold into which comparatively large and complex units of experience can be poured. Coleridge finds metre appropriate only when the concomitant elements in the composition are in keeping with it. But metre can also become an

[50] It is impossible to go into this idea here; a clear explanation would require as much space again as this essay. As good a clue as any may be found in Coleridge's letter on the subject of the invention of the steam engine. The power to see the possibilities in steam was reserved "for the genial spirit that *saw* what it had been *seeking* and saw because it sought." — *Letters*, 1 : 429.

[51] *Biog. Lit.*, Chap. XXII; 2 : 103.

active agency through which the poet shapes varied materials to his purposed ends.

But let us remember that volition alone is insufficient. Precedent to it, at least coexisting with it, working as a dynamic, complementary element, is spontaneous activity. Metre, Coleridge says, in effect, results from passion in balance with a spontaneous effort at restraint, acted upon by the will and judgment, "consciously and for the foreseen purpose of pleasure." In poetical creation these contrasting forces must be made to react upon each other in harmonious reciprocal relationship:

> Assuming these principles, as the data of our argument, we deduce from them two legitimate conditions, which the critic is entitled to expect in every metrical work. First, that, as the *elements* of metre owe their existence to a state of increased excitement, so the metre itself should be accompanied by the natural language of excitement. Secondly, that as these elements are formed into metre *artificially* by a *voluntary* act, with the design and for the purpose of blending *delight* with emotion, so the traces of present *volition* should throughout the metrical language be proportionately discernible. Now these two conditions must be reconciled and co-present. There must be not only a partnership, but a union; an interpenetration of passion and of will, of *spontaneous* impulse and of *voluntary* purpose.[52]

Here, so far as I know, is Coleridge's most direct answer to the problem of conflict between spontaneity and volition. The conflict no longer remains a conflict; but oppositions are reconciled, become in fact resolved into union. The poetry which results has within it the qualities of the natural language of passion, disciplined by the will, however, from any lawless tendencies into acceptable and beautiful forms. The original imaginative activity which produced the materials was spontaneous; but these materials were given objective form through a willed effort.

The frequent reference to metre in the foregoing discussion might easily suggest that to Coleridge the difference between prose and poetry lay in metrical form, but a study of all he had to say on the subject shows that metre was with him far from being the sole distinguishing mark of poetic composition.[53] Of the many passages

[52] *Biog. Lit.*, Chap. XVIII; 2: 50.

[53] It must be admitted that, fond as he was of distinctions, and valid as these distinctions usually were — for he was at bottom no muddlehead —

which would indicate a demand for metre I have already quoted the one in which Coleridge takes the stand, based on "an appeal to the practice of the best poets of all countries and in all ages — that in every import of the word ESSENTIAL . . . there may be, is, and ought to be an *essential* difference between the language of prose and of metrical composition." [54] In his 1811 lectures, as reported by Collier, he speaks quite as definitely:

> Part of my definition . . . would apply equally to the arts of painting and music, as to poetry; but to the last are added words and metre, so that my definition is strictly and logically applicable to poetry. . . .[55]

And in one of the 1818 lectures he declares:

> Now this definition applies equally to painting and music as to poetry; and in truth the term poetry is alike applicable to all three. The vehicle alone constitutes the difference; and the term "poetry" is rightly applied by eminence to measured words. . . .[56]

By "measured" words, Coleridge means, I assume, metre. Again, he says:

Coleridge could be on occasion irritatingly careless in his choice of terminology in which to express his ideas. The word "poetry," for instance, sometimes meant artistic literary quality as opposed to science; sometimes, it was the finest flower of the perfected imagination, as at the end of Chapter XIV of the *Biographia Literaria;* and again it was used merely to distinguish metrical from prose language.

[54] In the following, there is a distinct suggestion of poetic levels, and a grudging reluctance to accept very low forms as poetry, merely on the basis of metre or rhyme, yet they *are* accepted:

"A poem contains the same elements as a prose composition; the difference therefore must consist in a different combination of them, in consequence of a different object being proposed. According to the difference of the object will be the difference of the combination. It is possible, that the object may be merely to facilitate the recollection of any given facts or observations by artificial arrangement; and the composition will be a poem merely because it is distinguished from prose by metre, or by rhyme, or by both conjointly. In this, the lowest sense, a man might attribute the name of a poem to the well-known enumeration of the days in the several months;

'Thirty days hath September,
April, June, and November,' &c.

and others of the same class and purpose, and as a particular pleasure is found in anticipating the recurrence of sounds and quantities, all compositions that have this charm super-added, whatever be their contents, *may* be entitled poems." — *Biog. Lit.*, Chap. XIV; 2: 8, 9.

[55] Collier, p. 18. [56] Shedd, 4: 39.

> But if the definition sought for be that of a *legitimate* poem, I answer, it must be one, the parts of which mutually support and explain each other; all in their proportion harmonizing with, and supporting the purpose and known influences of metrical arrangement.[57]

And there is nowhere a more unmistakable demand for metre than in his argument against Wordsworth in the *Biographia:*

> Thirdly, I deduce the position from all the causes elsewhere assigned, which render metre the proper form of poetry, and poetry imperfect and defective without metre.[58]

But quite as frequently Coleridge asserts or implies that metre is not the significant differentia of poetry and prose. Thus in John Payne Collier's transcription of the 1811 lectures on Shakespeare and Milton, there is a note to the first lecture to the effect that Coleridge, quoting from Jeremy Taylor, observed that "although Jeremy Taylor wrote only in prose, according to definitions of poetry he might be considered one of our noblest poets." That this is no mere passing idea is shown by its repetition in expanded form a few years later in the *Biographia:*

> The writings of Plato, and Bishop Taylor, and the "Theoria Sacra" of Burnet, furnish undeniable proofs that poetry of the highest kind may exist without metre. . . . The first chapter of Isaiah (indeed a very large portion of the whole book) is poetry in the emphatic sense.[59]

Other instances of denial of the claims of metre occur in such emphatic statements as, "Harmonious versification no more makes poetry than mere invention makes a poet;" [60] and "Nobody means mere metre by poetry; so mere rhyme is not poetry." [61]

The truer test of poetry is its essential quality and effect:

> It is essential to poetry that it be simple and appeal to the elements and primary laws of our nature; that it be sensuous, and by its imagery elicit truth at a flash; that it be impassioned, and be able to move our feelings and awaken our affections. . . . This I must say, that poetry, as distinguished from other modes of composition, does not rest in metre, and that it is not poetry, if it make no appeal to our passions or our imagination.[62]

From these and similar statements it becomes clear that metre alone is not productive of poetry. Metre, to be efficacious, must exist in a congenial habitat, must be reinforced by effective allies. "If metre be superadded, all other parts must be made consonant

[57] *Biog. Lit.*, Chap. XIV; 2 : 10.
[58] *Ibid.*, 2 : 55.
[59] *Ibid.*, Chap. XIV; 2 : 11.
[60] Collier, p. 15.
[61] *Ibid.*, p. 16.
[62] Shedd, 4 : 56.

with it." [63] Metre has power "to increase susceptibility both of the general feelings and of the attention." Yet "for any *poetic* purposes, metre resembles . . . yeast, worthless or disagreeable by itself, but giving vivacity and spirit to the liquor with which it is proportionally combined." [64] Wordsworth, Coleridge complains, when he is wanting a statement of the powers of metre "considered abstractly and separately . . . seems always to estimate metre by the powers which it exerts during . . . its combination with other elements of poetry." [65] But Coleridge's own general argument also presupposes the existence of these other elements in all true poetry. Where he does not find them, he sees no valid excuse for poetic form. Thus in certain cases where the subject and emotion are not suitable metre fails to justify itself:

> Nay, I will confess, that, in Mr. Wordsworth's own volumes, the "Anecdote for Fathers," "Simon Lee," "Alice Fell," "The Beggars," and "The Sailor's Mother" . . . would have been more delightful to me in prose. . . .[66]

If metre is not the final test of poetry what then is? Evidently we must look for further criteria. Unquestionably, as evidence already presented would prove, one requirement is music. "'The man that hath not music in his soul' can indeed never be a genuine poet." [67] Other things can be learned as means to an arbitrary end,

> But the sense of musical delight, with the power of producing it, is a gift of the imagination; and this together with the power of reducing multitude into unity of effect, and modifying a series of thoughts by some one predominant thought or feeling, may be cultivated and improved, but can never be learned. It is in these that "poeta nascitur non fit." [68]

Even had no Lear, no Othello, no Henry IV appeared, says Coleridge, we must have known that Shakespeare possessed the chief requisite of a poet — "deep feeling and exquisite sense of beauty, both as exhibited to the eye in the combinations of form and to the ear in sweet and appropriate melody."

Milton "sought to produce glorious paragraphs and systems of harmony. In Milton you have

> . . . Many a winding bout
> Of linked sweetness long drawn out." [69]

[63] *Biog. Lit.*, Chap. XVIII; 2 : 9. [64] *Ibid.*, 52. [65] *Ibid.*, 51.
[66] *Ibid.*, 53. [67] *Ibid.*, 14. [68] *Ibid.* [69] Collier, p. 19, 20.

Spenser is praised for his music, with a partial reservation for the very exquisiteness of it:

> Spenser's *Epithalamion* is truly sublime; and pray mark the swan-like movement of his exquisite *Prothalamion*. His attention to metre and rhythm is sometimes so extremely minute, as to be painful even to my ear; and you know how highly I prize good versification.[70]

Verse is musical:

> The old poets had no other reason but this, their verse was sung to music: otherwise it had been a senseless thing to have fettered up themselves. . . . Verse is in itself a music, and the natural symbol of that union of passion with thought and pleasure, which constitutes the essence of all poetry, as contradistinguished from science, and distinguished from history civil or natural. To Pope's *Essay on Man*, — in short, to whatever is mere metrical good sense and wit, the remark applies.[71]

The source of any work of art, with Coleridge, was an experience, an experience, moreover, of a totality — a single poetic apprehension in which "multeïty," to use his own term, is fused into unity. This unity is a peculiarly harmonious unity, in which every part may be said to sing in tune with the whole. The power thus to apprehend is a distinctive "gift of the imagination," the imaginative way of seeing things. True of any work of art, this would be applicable to prose as well as to poetry, but to poetry in the greater degree. Before the poet can "produce glorious paragraphs and systems of harmony," he must perceive musically. Remember Coleridge's own metaphoric description of poetic seeing: "a covey of poetic partridges and with whirring wings of music, or wild ducks *shaping* their rapid flight *in forms always regular*." [72] Poetic experience, one might say, then, is a sort of musical apprehension of a harmony, one in which thought and feeling blend, in which every part is perfectly fitted to the whole, the whole to the parts, in which irrelevancies and discrepancies and conflicts have been dissolved, through power of the creative ("secondary") imagination, into a purposed unity.

Now, although metrical language is uniformly productive of musical effect, musical effects may be had without metre, and when Coleridge includes in poetry the writings of Plato, Bishop

[70] *Table Talk*, June 24, 1827. P. 64, Oxford reprint, 1917.
[71] Shedd, 4: 379. [72] *Letters*, 1: 378. See fuller quotation, p. 573.

Taylor, Burnet and Isaiah, he is making no qualifications to his demand for music. As we have seen, the Song of Deborah is poetry: it is not metrical, but it has a music of its own built on the tautological repeat of natural passion. The point is that when Coleridge talks of "metrical composition" and "the language of poetry," he has in mind something more than regular beat and a certain type of individual word or sentence. He is thinking rather of the "formal construction, or architecture, of the words and phrases." [73] That is, just as one could say "that the style of architecture of Westminster Abbey is essentially different from that of St. Paul's, even though both had been built with blocks cut into the same form and from the same quarry," so one could say that poetic style differs from prose style, even though the same units of language are used.[74]

Getting at this question of the essential architectural difference between prose and poetry, Coleridge comes down in Chapter XVIII of the *Biographia* to a specific issue:

> For the question is not, whether there may not occur in prose an order of words which would be equally proper in a poem; nor whether there are not beautiful lines and sentences of frequent occurrence in good poems, which would be equally becoming as well as beautiful in good prose; for neither the one nor the other has ever been either denied or doubted by any one. The true question must be whether there are not modes of expression, a *construction* and an *order* of sentences, which are in their fit and natural place in a serious prose composition, but would be disproportionate and heterogeneous in metrical poetry; and, vice-versa, whether in the language of a serious poem there may not be an arrangement both of words and sentences, and a

[73] *Biog. Lit.*, Chap. XVII; 2: 48.

[74] This, too, is essentially Wordsworth's actual position. It is the use and arrangement of words in context, not the words *per se*, which are productive of poetic form. Wordsworth, it is found by reading the Preface, justifies the poet for writing in verse under three main heads: first, verse is a much more natural language of sustained emotion than is prose, having within itself greater power to produce the desired effect of sustained pleasurable excitement in the reader; second, it always heightens the sense of the unusual, metre particularly tending "to divest language, in a certain degree, of its reality, and thus to throw a sort of half-consciousness of unsubstantial existence over the whole poem"; third, control in metrical language provides an element of regularity to temper and restrain what might otherwise be unconfined emotion. Metrical arrangement has power to produce "continual and regular impulses of pleasurable surprise," which largely accounts for the fact that poetry can make even the unpleasant and tragic agreeable.

use and selection of (what are called) *figures of speech*, both as to their kind, their frequency, and their occasions, which on a subject of equal weight would be vicious and alien in correct and manly prose. I contend that in both cases this unfitness of each for the place of the other frequently will and ought to exist.[75]

Here, it seems to me, Coleridge is getting onto ground that is of first importance to a comprehension of poetic form; he is dealing with a point which if understood would once for all do away with the febrile demand, which even some of our better contemporary journals still make, for verses that scan to precise and regular beat. It is not individual line, nor even, necessarily, the individual sentence, which determines poetic effect, but rather the force of words in specific context, the general architectural design into which the language is thrown, the larger rhythmic patterns it assumes. He and Wordsworth seemed to agree in this. Relating the particulars of a visit to Klopstock (1798), Coleridge tells how Wordsworth explained his notion of blank verse:

> . . . and my friend gave his definition and notion of harmonious verse, that it consisted (the English iambic verse above all) in the apt arrangement of pauses and cadences, and the sweep of whole paragraphs,
>
> . . . "with many a winding bout,
> Of linked sweetness long drawn out,"
>
> and not in the even flow,[76] much less in the prominence or antithetic vigour, of single lines, which were indeed injurious to the total effect, except where they were introduced for some specific purpose.[77]

Now, there must, of course, be boundaries — a place where it is appropriate for prose to enter the texture of poetic language, and a point beyond which it would be impossible for it to remain. A fairly definite test for this, implicit rather than explicit, is stated by Coleridge in his *Biographia*, where, discussing distinctions between prose and poetry, he points out that the existence of "prosaisms" in verse can be detected and must be conceded as detracting from the merit of a poem whenever "a number of successive lines

[75] *Biog. Lit.*, Chap. XVIII; 2: 49.

[76] In the Preface Wordsworth begins what promises to be a highly instructive exposition of a chief principle in art: "namely, the pleasure which the mind derives from the perception of similitude in dissimilitude," but he breaks off with a mere suggestion of his idea.

[77] *Ibid.*, Satyrane's Letters, 2: 170.

can be rendered, even to the most delicate ear, unrecognizable as verse, or as having even been intended for verse, by simply transcribing them as prose," or "when, if the poem be in blank verse, this can be effected by merely restoring one or two words to their proper places, from which they have been transplanted," or, "if it be in rhyme, by the mere exchange of the final word of each line by some other of the same meaning."

Coleridge finds such a passage in *The Brothers* of Wordsworth, whose poems and theories are just then on the carpet. By making two simple changes — in each case a shift of the word "there" — Coleridge finds the extract unquestionable prose. "James, pointing to its summit, over which they had all purposed to return together, informed them that he would wait for them there. They parted, and his comrades passed that way some two hours after, but they did not find him at the appointed place, *a circumstance of which they took no heed:* but one of them, going by chance into the house, which at this time was James's house, learnt there, that nobody had seen him all that day." [78] But usually in Wordsworth's poetry, we may assume, Coleridge has not been troubled by the touches of prose; such as have existed have seldom extended themselves into "prosaisms," but have been absorbed into the larger rhythms of the piece.[79]

How this works out in modern verse may be well illustrated by reference to such a poem as Robinson Jeffers' *Cawdor*. Jeffers has here written poetry which should live. It is poetic in substance and significant in form. In detailed structure it is not metrical, but cadenced, that is, prevailingly; and sometimes it is clearly prose, marked off into lines. But there is such a nice blending, a brief bit of prose merged into poetic cadence, which again dies into the more sober rhythm of prose, all caught up into the enveloping musical pattern, that the total effect is not only one of poetry, but of a fine artistic integrity. A brief glance at certain passages in this poem will show this mingling of forms, a successful merging of prose into poetry. One of the most notable passages —

[78] *Biog. Lit.*, Chap. XVIII; 2 : 62.

[79] Exceptions would be *The Sailor's Mother*, *Anecdote for Fathers*, and perhaps a few others. See Shawcross, 2 : 53 and 62.

in part notable because the poetry here rises to a height which for sheer energy and freedom invites comparison with some of those nobly soaring lyrics in Shelley's *Prometheus*, and Swinburne's *Atalanta* — is that in which Michal's eagle is killed. Though the scene is one of intense emotion, the beginning is pure prose —

> While George went to the house for his revolver, Michal climbed up the hill weeping; but when he came
>
> with death in his hand
> She'd not go away, but watched.

The metaphoric "death in his hand" begins to yield poetry, and there is in it the beginning of cadence, continuing to the end of the sentence, and through the splendidly simple, richly poetic descriptive passage which follows:

> At the one shot
> The great dark bird leaped at the roof of the cage
> In silence and struck the wood; it fell, then suddenly
> Looked small and soft, muffled in its folded wings.

The next three lines, calmly expository, are in movement only a shade off prose; the poetic effect is largely in diction and tonal quality:

> The nerves of men after they die dream dimly
> And dwindle into their peace; they are not very passionate,
> And what they had was mostly spent while they lived.

After that comes a brief space of slightly heavier cadence, with parallelism to strengthen the movement:

> They are sieves for leaking desire; they have many pleasures
> And conversations; their dreams too are like that.
> The unsocial birds are a greater race;
> Cold-eyed, and their blood burns.

Now one feels a rising excitement. The calm of deep, restrained emotion gives way to the released energy of full expression:

> What leaped up to death,
> The extension of one storm-dark wing filling its world,
> Was more than the soft garment that fell. Something had
> flown away. Oh cage-hoarded desire,
> Like the blade of a breaking wave repeated by the wind, or
> flame rising from fire, or cloud-coiled lightning
> Suddenly unfurled in the cave of heaven: I that am
> stationed, and cold at heart, incapable of burning,

My blood like standing sea-water lapped in a stone pool
my desire to the rock, how can I speak of you?
Mine will go down to the deep rock.

This rose,
Possessing the air over its emptied prison,
The eager powers at its shoulders saving shadowless
Unwound the ever-widened spirals of flight
As a star light, it spins the night-stabbing threads
From its own strength and substance: so the aquiline desire
Burned itself into meteor freedom and spired
Higher still, and saw the mountain-dividing
Canyon of its captivity (that was to Cawdor
Almost his world) like an old crack in a wall,
Violet-shadowed and gold-lighted; the little stain
Spilt on the floor of the crack was the strong forest;
The grain of sand was the Rock. A speck, an atomic
Center of power clouded in its own smoke
Ran and cried in the crack; it was Cawdor; the other
Points of humanity had neither weight nor shining
To prick the eyes of even an eagle's passion.

This burned and soared. The shining ocean below lay on
the shore
Like the great shield of the moon come down, rolling
bright rim to rim with the earth.

"This burned and soared." And language, winding itself into spiral chains of light burns and soars after it; prose is left behind as poetry takes her rightful place in a leaping flight into higher, unearthly spaces.

When should prose become poetry? When the subject-matter and the personal emotion of the writer are such as to demand a departure from the normal diction and word combinations of prose, one would say; and would certainly have to add: "when the writer has the power to construct the forms requisite for poetic effect." This might be metrical, but it need not be; it is only necessary that the form shall fit and express the mood.

Wordsworth had said that except for five lines in Gray's sonnet beginning

"In vain to me the smiling mornings shine,"

there was no poetry in it, that the language of these five lines even "does in no respect differ from that of prose." In Coleridge's

objection to this statement, four principles for differentiating poetic language from prose evolve.[80] The first two have to do with the arrangement of words; the second two with the choice of words in context and the use of figurative language.

First, the principle of metre, which has been discussed and needs no elaboration here.

Second, the principle of *position* —

> Of the five lines thus honorably distinguished, two of them differ from prose, even more widely than the lines which either precede or follow, in the *position* of the words.
>
> "*A different object do these eyes require;*
> My lonely anguish melts no heart but mine;
> *And in my breast the imperfect joys expire.*" [81]

Miltonic inversion furnishes, of course, the classic example of the point which Coleridge is here making.[82]

> Thus the orb he roamed
> With narrow search, and with inspection deep
> Considered every creature, which of all
> Most opportune might serve his wiles, and found
> The Serpent subtlest beast of all the field.
> Him, after long debate, irresolute
> Of thoughts revolved, his final sentence chose
> Fit vessel, fittest Imp of fraud, in whom
> To enter, and his dark suggestions hide
> From sharpest sight. . . . (*Paradise Lost*, Bk. IX)

Though it is presumably not so popular a device as it once was, the inverted word order is still very frequently an indication of the almost intangible shift from prose to poetic effects. Thomas

[80] This discussion occurs in Chapter XVIII, beginning on page 48 (Shawcross, 2). The first ten pages contain an elaborate argument on the origin and effects of metre in its relation to our demand for "unity by harmonious adjustment" which is satisfied in good poetry. The essential material here has been introduced earlier in this essay. The particulars of the further argument I am here noticing are obscured in a haze of wandering comment and indefinite terminology, and emerge only upon close study, with free supplement from other passages.

[81] *Biog. Lit.*, Chap. XVIII; 2 : 57.

[82] "The collocation of words is so artificial in Shakespeare and Milton, that you may as well think of pushing a brick out of a wall with your forefinger, as attempt to remove a word out of any of their finished passages." — Coleridge, *Table Talk*, July 3, 1833.

Hardy does not quite belong to the present generation, but he is so near to it as to justify quotation here:

> Time has trailed lengthily since *met*
> *At Pummery Fair*
> *Those panting thousands* in *their wet* and *woolly* wear:
> And every flock long since has bled,
> And all the dripping buyers have sped,
> And the hoarse auctioneer is dead,
> Who "Going-going!" so often said,
> As he consigned to doom each meek, mewed band
> At Pummery Fair.

Even in a writer like Robert Frost, contemporary master of natural language, examples of inverted order for poetic effect are not difficult to find, as in *The Generation of Men:* [83]

> A governor it was proclaimed this time
> When all who would come seeking in New Hampshire
> Ancestral memories might come together.

Likewise, T. S. Eliot, who certainly does not habitually rely on position of words, furnishes modern instances of the thing Coleridge was talking about; as in his *Cousin Nancy,*

> Upon the glazen shelves kept watch
> Matthew and Waldo, guardians of the faith,
> The army of unalterable law.

And in this from *Sweeney among the Nightingales,*

> Gloomy Orion and the Dog
> Are veiled; and hushed the shrunken seas.

Coleridge proceeds from the construction and order of words and sentences to the choice of words and phrases. His test is based on the principle that certain epithets are incompatible with prose.

The first line of this sonnet is distinguished from the ordinary language of men by the epithet to morning. And here Coleridge goes on to point out that the epithet "smiling" in the line "In vain to me the *smiling* mornings shine," indicates that the writer

[83] Everyone knows of course that *mere* inversion will not produce poetry. Indeed, position of words *alone* has so little to do with the real spirit of poetry that one hesitates to mention it at all. Position is only an integrating factor working with more vital elements toward the desired effect.

had "a song in his head"; hence this is not the language of prose. Such epithets do not, I think, always indicate a song, but they do in some way suggest the heightened excitement of poetry. The principle may be admirably illustrated by a further reference to Robinson Jeffers' *Cawdor*.

> While George went up to the house
> For his revolver, Michal climbed up the hill
> Weeping; but when he came with death in his hand
> She'd not go away, but watched.

Now just as "smiling morning" would not do in prose, the phrase "with death in his hand" is plainly poetic. The phrase would be impossible in prose, and would inevitably become "with his gun (or revolver) in his hand."

How is one to tell when a word or phrase is poetic, when prosaic? "Smiling" is not in itself a poetic word. Witness "Zeke was smiling." Nor is "death," as any one of a hundred combinations will instantly show: for example, "Some people are so silly as to be afraid of death." But in the particular combinations given above both words become undeniably productive of poetic effect. That this effect is not due to rhythm or sentence movement can easily be seen by adding an adjunct to "death," making the syllables equal, in number at least, to "He came with *a gun* in his hand"; thus: "He came with *dark death* in his hand." One must conclude, I think, that the poetic effect really lies, as Coleridge implies it does, in the power of these lines to convey to the reader the poetic content in the mind of the writer.

Fourth, he mentions the principle of figurative language in general, of metaphor, personification and so forth, represented in the wretched, but still poetic (that is, not-prose) line,

> And reddening Phoebus lifts his golden fire.

The personification in "Phoebus" and the decisive metaphoric quality of the whole line is a mark of poetic language. Here it is not so much a matter of using a word in a certain combination as employing a term in itself poetic. "Phoebus" is a poetic word in a sense that "smiling" and "death" are not. Likewise with a word like "matin" in Shakespeare's

> The glow-worm shows the *matin* to be near
> And 'gins to pale his ineffectual fire.

This sort of thing is often said to have gone out in modern poetry. The "'gins" certainly has, but how about the mythologic term? Shakespeare was satirizing when he wrote,

> Full thirty times hath Phoebus' cart gone round
> Neptune's salt-wash and Tellus' orbed ground.

But Scofield Thayer is certainly seriously himself in his *Dawn from a Railway Coach* (*Dial*, 1925) when he writes:

> The nickeled orb Apollo
> Brays
> The disarticulated limbs of life
> Assemble
> And Time walks.

This is personification and extended metaphor with emphasis. It is an interesting speculation whether such figurative expression, however obvious its unfitness for prose, will ever become entirely obsolete in poetry. Coleridge's contention seems to hold that poetry

> not only dictates, but of itself tends to produce, a more frequent employment of picturesque and vivifying language, than would be natural in any other case, in which there did not exist . . . a previous and well-understood, though tacit, *compact* between the poet and his reader, that the latter is entitled to expect, and the former bound to supply, this species and degree of pleasurable excitement.[84]

As for other of the more "artificial" marks of poetic form, Coleridge would justify figurative language to the extent that whatever pleasure was to be derived from it as an element in poetry should be compatible with the pleasure to be derived from the composition as a whole. This implies much: a worthy subject, a definite aim, a sustained, unified composition of which every part is an integral and harmonious unit conforming to that aim. For poetry is "the art of communicating whatever we wish to communicate, so as both to express and produce excitement, but for the purpose of immediate pleasure; and each part is fitted to afford as much pleasure, as is compatible with the largest sum in the whole." [85] The equivalent of this statement, with or without

[84] *Biog. Lit.*, Chap. XVIII; 2: 50. [85] Collier, p. 17.

elaboration, occurs in various places in Coleridge. Perhaps the clearest instance is to be found in the *Biographia*. Metre in its relation to poetic effect is under discussion:

> The answer is, that nothing can permanently please, which does not contain in itself the reason why it is so, and not otherwise. If metre be superadded, all other parts must be made consonant with it. They must be such, as to justify the perpetual and distinct attention to each part, which an exact correspondent recurrence of accent and sound are calculated to excite. The final definition then, so deduced, may be thus worded. A poem is that species of composition, which is opposed to works of science, by proposing for its *immediate* object pleasure, not truth; and from all other species (having *this* object in common with it) it is discriminated by proposing to itself such delight from the *whole*, as is compatible with a distinct gratification from each component *part*.[86]

A fifth distinction was cited earlier: in addition to justifying new combinations of words, poetry "commands the omission of many others allowable in other compositions." [87] Perhaps the first stanza of Coleridge's own *Ancient Mariner* will illustrate the tendency to omission as well as anything else:

> It is the ancient Mariner,
> And he stoppeth one of three.
> "By thy long gray beard and glittering eye,
> Now wherefore stopp'st thou me?"

The lines describing the Homeric hexameter may also be cited in point:

> Strongly it bears us along in swelling and limitless billows,
> Nothing before and nothing behind but the sky and the Ocean.

Or take this of Walt Whitman's:

> By the bivouac's fitful flame,
> A procession winding around me,
> solemn and sweet and slow — but first I note
> The tents of the sleeping army, the field's and
> woods' dim outline. . . .

The omissions are in each case obvious; and it is quite as clear that these omissions would not be endured in prose.

The practice of omission has been especially characteristic of modern verse. It is a somewhat natural accompaniment, to certain

[86] *Biog. Lit.*, Chap. XIV; 2: 9, 10. [87] See the first page of this essay.

contemporary theories, especially that which holds that poetry should not be too lucid. A fair statement of that view is contained in the following extract from I. A. Richards:

> Modern verse is perhaps more often too lucid than too obscure. It passes through the mind (or the mind passes over it) with too little friction and too swiftly for the development of the response. The effort, the heightened attention, may brace the reader, and that peculiar intellectual thrill which celebrates the step-by-step conquest of understanding may irradiate and awaken other mental activities more essential to poetry. It is a good thing to make a light-footed reader work for what he gets. It may make him both more wary and more appreciative of his reward if the "critical point" of value is passed.
>
> These are arguments for some slight obscurity in its own right. No one would pretend that the obscurity may not be excessive. It may be distracting, for example. But what is a distraction in a first reading may be non-existent in a second . . . and the reader is likely to be left with a far securer grasp of the whole poem, including its passional structure, than if no resistance had been encountered.[88]

Richards here means, as I understand him, not that poetry should be in itself obscure and enigmatic, but that anything, any idea, passion or experience, which is worth a poet's pains must have sufficient depth not to be obvious, cannot therefore be grasped at first glance, but will yield its meaning only after intelligent application has broken down resistance. But he also means that, even where the idea tends to be entirely clear, the poem should be thrown into such form that the light-footed reader will be made to work for what he gets. Coleridge, too, felt that a certain difficulty in getting meaning from a poem is requisite. He did say that a poem should "by its imagery elicit truth at a flash," but this need not be at the first reading; a poem, he contended, which can be fully understood at a single sitting is not worth reading. He felt, I imagine, that poetry owes much of its power to its suggestibility, and that the flash of full meaning finally comes with richer force through the re-creative act of fusing into unity what at first comes upon the mind as only vague intimations of truth. "The elder languages," he once wrote, "were fitter for poetry because they expressed only prominent ideas with clearness, the others but darkly. . . . Poetry gives most pleasure when only generally and not perfectly understood. It was so by me with Gray's 'Bard'

[88] *Dial*, 81 : 195.

and Collins' Odes. The 'Bard' once intoxicated me, and now I read it without pleasure." [89]

I do not feel, however, that when Coleridge spoke of an unusual order and the omission of words he was thinking of anything so artificial as an attempt to make poetry obscure or hard. Was he not, rather, recognizing the fact that our best poetry is bound to be concentrated, that often its very intensity commands a language inverted, spare, artificial (measured by prose standards), which suggests infinitely more than it directly expresses. Nobody knew better than Coleridge that magic power of creative suggestiveness which is the basis of great poetry.[90]

From what has preceded can we deduce anything like specific criteria for differentiating prose from poetry? Nothing final perhaps; but a brief survey of the ground we have traversed will at least reveal entertaining suggestions. First, poetry has its origin in a state of mind, in an experience, and, more definitely, in a sort of creative musical experience — of harmonies and wholes. A condition of this experience is emotion: poetry originates in passion or strong natural excitement. Second, its marks are a language which, both in its larger architectural design and in detailed structure, reflects the state of mind from which it arose. Such expression is purged of the commonplace and trivial; it bears within itself the evidence of its unique mission — the conveyance of significant idea under stress of a continued state of strong excitement in such a way as to create a certain state of mind in the reader. It finds fulfilment in a rhythmic unity in which each individual part bears an inalienable relationship toward the whole and performs a distinct function in a rhythmic progression toward completing that whole.

Wherein is prose different? Prose, too, can originate in strong passion or excitement, and can produce effects similar to those of poetry. Coleridge realized this, and in at least three places, his introductory lecture on Shakespeare in 1811 (as recorded by

[89] *Anima Poetae*, p. 4. Edition by Ernest Hartley Coleridge, Boston and New York, Houghton, Mifflin and Co., 1895.

[90] See Professor A. L. F. Snell's admirable discussion of Coleridge's verse in "The Meter of 'Christabel,'" *The Fred Newton Scott Anniversary Papers*, The Chicago Press, 1929.

Collier), his introductory lecture in 1818,[91] and in the *Biographia*,[92] admitted that novels and other artistic prose works were not different from poetry in these respects; and in each case he resorted to the fallacious expedient of naming metre as the distinguishing element in poetry. This, of course, is not compatible with his theory as a whole. The real distinctions are deeper ones. The prose writer does not see musically, does not necessarily see in such clearly organized wholes; he is further away from his original emotion than is the poet, and he is bound to exercise more control of it. The poet indeed must create under the control of the will and judgment; but the prose writer works under still greater restraint, if not real, at least apparent. There are certain things allowed to the poet not permitted to him. In the best poetry there is a fine balance exerted between voluntary effort and spontaneous energy. In prose it would appear that the voluntary is predominant, with spontaneity sublimated. Where the spontaneous and the emotional come to the surface in prose we have a hybrid, the "vile olio" poetic prose.

But the conventions of poetry permit more show of passion and emotion, and they permit song. The poet in the very choice of his medium is announcing his intention of taking advantage of certain recognized conventions which will permit him special liberties. He must indeed work within the limits of the form he has adopted — the very nature of poetry implies boundaries; he must exercise judgment and restraint. "High-flown epithets and violent metaphors conveyed in inflated language is not poetry. Simplicity is indispensable." [93] But, whereas the nature of prose implies at least the appearance of calm intellectual control, no matter how strong the original, or continued, emotional fires, poetry permits the emotion to reveal itself. Prose must conceal excitement, but "The very assumption that we are reading the work of a poet supposes that he is in a continuous state of excitement; and thereby arises a language in prose unnatural, but in poetry natural." [94] Hence the accustomed and legitimate appear-

[91] Shedd, 4: 20. [92] Chap. XIV; 2: 9. [93] Collier, p. 16.

[94] Collier, p. 18. This does not, I assume, deny Wordsworth's requirement that the emotion shall be "recollected in tranquillity." Coleridge is not asking

ance in poetry of an architectural design, an order and combination of words and sentences, an omission of words, a use of colorful epithet and picturesque figurative language not to be expected nor tolerated in good prose. These are all signs of the continued state of excitement under which the poet works.

The really distinctive quality that sets poetry off from prose seems then to lie in the *manner* of expression or communication. In the purest form of prose, the manner is represented in such a formula as "2 and 2 make 4," in other words, "so many ideas in so many words," as Thomas Sprat would have put it, while the purest form of poetry is found in such lines as

> Charmed magic casements opening on the foam
> Of perilous seas in faery lands forlorn,

which is well-nigh unadulterated suggestion.

An approach to a word selection, a word order — a mode of expression, in general — which approximates pure suggestion rather than precise statement of specific ideas is an approach to pure poetry as distinguished from pure prose. In pure prose we expect a simple, direct, unmistakably lucid statement of ideas. We do not accept metrical effects in good prose at all. We do indeed expect form in prose, but of a different sort. We do not demand a form which yields music, nor a form which produces excitement or immediate pleasure, nor one in which the character of the whole requires and justifies a certain quality, construction and embellishment in the parts. We no longer accept the schematic, patterned forms of Euphuistic and Arcadian prose; the scientific and philosophic demands of a more matter-of-fact seventeenth century, abetted by such writers as Sprat and culminating in the measured clarity of Dryden, Addison and Swift,

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that the poet write under stress of the original emotion; his doctrine, quite as clearly as Wordsworth's, implies an excitement generated from within through the influence of the reflective and re-creative imagination. I have in mind the implications of Coleridge's whole theory of the imagination as expressed in the definitions at the close of Chapter XIII of the *Biographia* and in his account of the origin of Wedgewood's conceptions as presented in Shedd, 1: 432. There would be general agreement I should imagine; Poe must be the only considerable poet who has held that a poem could be written mathematically, in cold blood, as it were.

delivered final sentence of death upon such absurdities. This, however, does not mean that prose does not have its liberties and its beauties. The conventions of prose require, indeed, rather specific limitations, but they deny neither rhythm, music, nor artistry. Writers like Sir Thomas Browne, Thomas De Quincey, John Ruskin, J. B. Cabell and Aldous Huxley have woven their ideas and emotions into undeniably musical prose — prose that marches, that rises and falls in sonorous cadences, that rounds itself into swelling phrases of rhythmic beauty. But prose is not permitted to sing, nor is it permitted to be too difficultly lean and irregular and suggestive. The fact is, we constantly demand of prose that it come much nearer to precision than poetry, even where we accept a maximum of artistry and suggestibility.

Let me repeat: what we accept in poetry and what we accept in prose are largely matters of convention. Purely metrical effect as a quality in poetry has nearly always been exaggerated. What is more to the point is that, relieved of the restraint of being required to say so many things in so many words, poetry has been left free to indulge in liberties with the language in the direction of shadowy suggestion, of subtle undertone, of piled-up half-thoughts, the cumulative effect of which, coming suddenly upon the mind when the meaning finally emerges, is often more powerful than that of more fully expressed prose.

When we sit down to read a poem we put ourselves into a certain frame of mind; we are prepared to accept the conventions of poetry. That is why, I think, we experience shock when we encounter certain modern forms of poetry in which we are not warned beforehand that here is verse. It is also the reason we feel discomfort in running into metrical or cadenced passages in the prose works of Ruskin, De Quincey and J. A. Symonds. There is nothing in a *line* with capitals at the beginning and possibly a tag at the end sacred to poetry or inherently unique, but the form does signal to us that we are to put ourselves into such an attitude as to be ready to conform to poetic conventions. In poetry, we accept not only metrical effect, but, along with that, more irregularity in word-combination, more that is unusual — in short, more *strangeness* in the method of expressing thought. That is,

we allow poetry to be more *artful.* We accept newer and older words, more figurative and picturesque language, a greater compression of idea, more condensation of phrase; and, whereas in prose we demand an immediate delivery of the thought through the medium of conventionally ordered, clear-cut phrase, in poetry we are willing to labor long over a passage, to wring out bit by bit the full flavor of its meaning, or even, in cases more extreme, to carry, for indefinite periods, stubborn, undefeated passages in memory, in vexed or patient siege as our temperaments may be, striving to woo away their secret charm.

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A COMPARISON OF TWO METHODS OF EXPANDING THE INVERSE SINE FUNCTION

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ACCORDING to a method used in many calculus texts, the infinite series in powers of x which represents the function arcsin x is obtained by integrating term by term the binomial expansion of

$$(1 - x^2)^{-\frac{1}{2}}$$

This leads to the series

$$(1) \quad \arcsin x = x + \frac{x^3}{3!} + p_3^2 \frac{x^5}{5!} + \cdots + p_{2k-3}^2 \frac{x^{2k-1}}{(2k-1)!} + \cdots,$$

where

$$(2) \qquad p_{2k-3} = 1.\ 3.\ 5 \cdots (2k-3),$$

which series converges in a certain interval whose precise size is not material for the purpose of this paper.

The direct application of the Maclaurin formula to the function arcsin x gives

$$(3) \quad y = \arcsin x = y_0' \cdot x + \cdots + y_0^{(2k-1)} \cdot \frac{x^{2k-1}}{(2k-1)!} + \cdots,$$

so that, by comparison with (1), it is seen that

$$(4) \qquad y_0^{(2k-1)} = p_{2k-3}^2 \qquad (k = 1, 2 \cdots).$$

The successive derivatives of y may be computed from the equation

$$y' = (1 - x^2)^{-\frac{1}{2}}.$$

The work is somewhat tedious, and will not be given. The tedium is rendered less by observing the occurrence of functions defined as follows:

$$(5)\quad \begin{aligned} S_n^{(1)} &= 1 + 2 + 3 + \cdots + n, \\ S_n^{(2)} &= 1 \cdot S_2^{(1)} + 2 \cdot S_3^{(1)} + \cdots + (n-1)S_n^{(1)}, \\ S_n^{(3)} &= 1 \cdot S_3^{(2)} + 2 \cdot S_4^{(2)} + \cdots + (n-2)S_n^{(2)}, \\ &\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots, \\ S_n^{(j)} &= 1 \cdot S_j^{(j-1)} + 2 \cdot S_{(j+1)}^{(j-1)} + \cdots + (n-j+1) \cdot S_n^{(j-1)}. \end{aligned}$$

With the help of these functions, the general derivatives of even and of odd order may be given as follows:

$$(6)\quad \begin{aligned} y^{(2k)} &= p_{4k-3}x^{2k-1}(1-x^2)^{-\frac{4k-1}{2}} + \cdots + p_{2k-1}S_k^{(k-1)}x(1-x^2)^{-\frac{2k+1}{2}}, \\ y^{(2k-1)} &= p_{4k-5}x^{2k-2}(1-x^2)^{-\frac{4k-3}{2}} + \cdots + p_{2k-3}S_{k-1}^{(k-2)}(1-x^2)^{-\frac{2k-1}{2}}. \end{aligned}$$

These may be justified by an induction, which will be omitted here.

The substitution $x = 0$ in (6) gives

$$y_0^{(2k)} = 0, \quad y_0^{(2k-1)} = p_{2k-3}S_{k-1}^{(k-2)}, \quad (k = 3, 4 \cdots),$$

and when the second of these is compared with (4), the following identities result:

$$S_{k-1}^{(k-2)} = p_{2k-3} \qquad (k = 3, 4, 5 \cdots).$$

For the special values $k = 3, 4, 5 \cdots$, these identities become

$$\begin{aligned} k = 3: &\quad S_2^{(1)} = p_3, \\ k = 4: &\quad S_3^{(2)} = p_5, \\ k = 5: &\quad S_4^{(3)} = p_7, \\ &\cdots\cdots\cdots\cdots, \end{aligned}$$

which, in view of (2) and (5), are

$$1 + 2 = 1 \cdot 3.$$

$$1 \cdot (1 + 2) + 2 \cdot (1 + 2 + 3) = 1 \cdot 3 \cdot 5.$$

$$1 \cdot [1 \cdot (1 + 2) + 2 \cdot (1 + 2 + 3)] + 2 \cdot [1 \cdot (1 + 2) + 2 \cdot (1 + 2 + 3) + 3 \cdot (1 + 2 + 3 + 4)] = 1 \cdot 3 \cdot 5 \cdot 7.$$

. . . . . .

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METEOROLOGICAL DATA, DOUGLAS LAKE, MICHIGAN*

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THE present paper is the final summary of the meteorological data obtained on the original site of the Biological Station of the University of Michigan at Douglas Lake, Cheboygan County, Michigan. In part this paper continues that printed in the *Twenty-First Annual Report of the Michigan Academy of Science*, pages 373–378, which applies to the period from 1912 through 1918, and the paper published in *Papers of the Michigan Academy of Science, Arts and Letters*, 4: 475–489, which brings the record through 1923. Through this article temperature is expressed in degrees Fahrenheit, precipitation in inches, evaporation and solar intensity in cubic centimeters per day. Averages are calculated from the grand totals. The averages are usually based on eighteen years' record of those periods in which the Station was in session and shorter periods before and after the Biological Station session, as indicated in the proper tables. These records indicate that the summers are mild with few periods of extremely high temperature, usually with fair to moderately warm days and cool nights, a high percentage of sunshine, and normally with but a modest amount of rain during the summer, even to the point of a drought in several instances.

Meteorological Summaries, 1912–29 (Table No. I)

This table includes Tables III and II, previously published in the *Twenty-first Annual Report of the Michigan Academy* and in Volume 4 of this series, respectively, but brings the data through 1929. The summaries of evaporation from standard

* Contribution 302 from the Department of Botany and Plant Pathology, Kansas State Agricultural College, Manhattan, Kansas.

Livingston atmometers and solar intensities from standardized blackened Livingston atmometers and included between 1915 and 1922. Solar intensity is expressed as c. c. of water evaporated from a black spherical atmometer in excess of that evaporated from a white atmometer. From 1926 on, solar temperatures were obtained by a standard black bulb *in vacuo* exposed in the usual manner.

Meteorological Averages (Table No. II)

In this table various meteorological features are shown for each fifth of a month. In June the temperature and precipitation figures are for from 6 to 14 years of record as shown in the table; those for July and August, except the last period, for 18 years. The averages for evaporation are based on 8 years of record, those of solar intensity on 4 years and those of temperatures in the sun on 4 years.

Meteorological Data, 1924–29 (Tables Nos. III and IV)

The daily maximum and minimum temperatures and precipitation for the days indicated bring the printed record to date. All of these records have been made with standard weather bureau instruments properly exposed.

Solar Maximum Temperatures, 1926–29 (Table No. V)

In this table are given the maximum temperatures reached in the full sun by a black bulb *in vacuo* exposed in a standard manner.

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TABLE I

WEATHER SUMMARIES, DOUGLAS LAKE, MICHIGAN

	TEMPERATURE					PRECIPITATION		EVAPORATION	SOLAR INTENSITY
	Abs. max.	Aver. max.	Abs. min.	Aver. min.	Mean	Ppt.	Days ppt.		
July, 1912	95	77.6	45	57.5	67.7	1.06	9	....	....
Aug., 1912	84	68.7	41	53.8	61.2	6.79	11	....	....
July, 1913	93	78.5	42	56.7	67.8	3.07	10	....	....
Aug., 1913	97	82.0	46	60.1	71.0	0.51	3	....	....
July, 1914	94	81.8	46	58.2	70.0	1.84	7	....	....
Aug., 1914	98	80.0	46	56.5	68.0	1.71	8	....	....
July, 1915	92	77.6	44	54.6	66.1	1.69	13	14.2	....
Aug., 1915	84	73.1	48	55.6	64.1	3.76	7	11.4	....
July, 1916	102	87.3	44	61.2	74.2	1.07	5	45.0	....
Aug., 1916	99	82.3	42	59.4	70.7	1.66	7	27.0	....
July, 1917	104	81.3	50	60.3	70.9	1.33	10	36.3	11.0
Aug., 1917	86	76.2	43	56.6	66.2	2.14	9	24.3	6.1
July, 1918	98	79.2	39	55.2	67.2	1.39	7	29.9	....
Aug., 1918	90	79.9	42	55.9	67.6	2.52	8	25.4	....
July, 1919	96	81.8	38.5	55.2	66.9	1.23	6	31.1	16.1
Aug., 1919	90	76.4	46	56.3	66.4	2.03	5	22.5	11.9
June, 1920	96	78.3	43	56.2	67.3	2.34	10	....	....
July, 1920	87	73.1	39.5	52.4	62.7	2.77	11	32.6	8.6
Aug., 1920	88	76.4	40	53.0	64.7	3.54	6	28.8	6.2
June, 1921	91	82.6	28	54.6	68.6	1.11	5	....	....
July, 1921	100	87.6	52	62.8	75.2	2.41	9	34.1	17.9
Aug., 1921	87	72.4	43	54.2	63.3	4.13	11	23.4	11.7
June, 1922	87	71.8	30	50.5	60.9	2.92+	6	....	....
July, 1922	87	74.4	42	54.1	64.3	6.05	12	21.9	9.3
Aug., 1922	91	76.6	45	55.9	66.1	2.27+	4	19.0	12.4
June, 1923	95	79.2	37	52.5	65.9	1.85	5	....	....
July, 1923	94	81.6	45	53.0	67.3	1.62	10	....	....
Aug., 1923	89	74.7	37	49.4	61.6	3.21	8	....	....

TABLE I (*Continued*)

WEATHER SUMMARIES, DOUGLAS LAKE, MICHIGAN

	TEMPERATURE					PRECIPITATION		Solar max.	Solar average
	Abs. max.	Aver. max.	Abs. min.	Aver. min.	Mean	Ppt.	Days ppt.		
June, 1924	87	75.1	43	49.9	62.5	1.69+	5+	...	...
July, 1924	91	77.0	41	52.7	64.9	3.87	11	...	...
Aug., 1924	89	73.6	42	52.9	63.2	4.47	9	...	...
June, 1925	80	71.5	34	47.8	59.6	3.40+	10+	...	...
July, 1925	91	77.2	40	52.5	64.8	2.99	9	..	...
Aug., 1925	95	83.9	49	54.9	69.4	0.13+	3+	...	...
June, 1926	82	72.4	36	48.3	60.3	0.84+	5+	...	...
July, 1926	91	80.7	40	51.6	66.1	2.40	9	154	140
Aug., 1926	90	76.8	44	55.7	66.2	2.13	12	156	135
June, 1927	98	....	37	....	....	....	.	...	...
July, 1927	102	79.0	38	53.2	66.1	2.71	10	159	135
Aug., 1927	86	74.6	36	46.4	60.5	0.15+	2+	145	137
June, 1928	82	73.5	35	51.1	62.3	3.64+	8+	148	127
July, 1928	97	79.5	43	56.1	67.8	3.25	12	151	137
Aug., 1928	91	81.8	46	55.9	68.8	2.24	3	156	140
June, 1929	93	77.8	42	51.5	64.6	2.66+	7+	152	...
July, 1929	95	81.4	40	53.5	67.4	2.47	8	156	...
Aug., 1929	87	74.8	39	50.7	62.7	2.52	8	151	140

TABLE II

Meteorological Averages, 1912–29, Douglas Lake, Michigan

	Years of record	Absolute maximum	Absolute minimum	Average maximum	Average minimum	Mean	Solar maximum absolute	Solar maximum average	Precipitation	Days precipitation	Maximum precipitation in one day
June 1–6	..	84	28	....	....	....	...	...	....	...	....
7–12	6	96	38	76.4	52.9	64.7	...	...	0.69	2.0	1.20*
13–18	9	93	34	76.1	50.3	63.2	152	134	0.92	1.8	2.24
19–24	12	95	36	76.8	53.2	65.0	140	122	0.47	1.5	1.48
25–30	14	98	30	75.8	51.5	63.6	155	126	0.51	1.6	1.10
Average or extremes	..	98	28	76.3	52.0	64.1	155	...	2.59+	6.9+	2.24
July 1–6	18	102	38	79.6	53.2	66.4	159	137	0.46	1.6	1.00
7–12	18	99	38.5	78.7	55.4	67.1	148	133	0.64	2.3	1.73
13–18	18	98	42	79.7	56.0	67.8	151	143	0.48	2.0	1.27
19–24	18	100	40	80.3	56.0	68.2	154	134	0.40	1.6	0.82
25–31	18	104	40	80.6	56.9	68.8	156	144	0.44	1.9	0.85
Average or extremes	..	104	38	79.8	55.5	67.7	159	138	2.42	9.3	1.73
Aug. 1–6	18	99	36	77.0	55.0	66.0	156	132	0.50	1.7	1.97
7–12	18	98	38	77.4	55.1	66.3	156	142	0.84	2.3	2.20
13–18	18	97	40	77.0	54.3	65.6	148	138	0.55	1.4	1.28
19–24	16	97	39	74.9	54.1	64.5	150	136	0.63	1.3	1.45
25–31	10	90	37	75.8	53.1	64.5	156	141	0.52	1.1	1.92*
Average or extremes	..	99	36	76.4	54.3	65.4	156	138	3.04	7.8	2.20

* Two days.

TABLE III

MAXIMUM AND MINIMUM TEMPERATURES, DOUGLAS LAKE, MICHIGAN
(Degrees Fahrenheit)

	1924		1925		1926		1927		1928		1929	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
JUNE 10	..	..	58	43	..	..	..	..	..	..	..	..
11	71	..	—	45	..	..	..	..	..	..	..	..
12	72	49	80	49	..	..	..	..	..	..	..	..
13	77	51	—	61	..	..	..	..	..	..	..	..
14	81	43	—	57	..	..	..	..	..	..	..	..
15	64	51	—	—	..	..	..	..	78	35	..	..
16	65	43	79	53	78	—	..	..	79	37	87	47
17	76	48	75	48	72	55	..	..	65	44	93	54
18	73	45	75	53	55	47	..	..	79	52	92	60
19	81	45	74	46	65	42	..	..	75	56	79	62
20	79	58	77	55	72	36	..	..	61	54	83	49
21	81	59	74	54	78	50	..	..	80	58	82	53
22	87	56	80	46	74	50	..	..	78	51	68	53
23	75	58	72	46	66	48	..	..	70	57	76	51
24	75	51	69	40	74	58	70	—	71	56	77	46
25	78	43	78	53	77	43	68	57	57	54	72	52
26	80	46	62	46	64	49	72	49	75	54	72	42
27	86	47	60	35	75	40	81	37	79	43	65	43
28	61	53	64	34	82	55	93	49	77	57	64	53
29	70	55	67	44	80	58	93	70	69	55	78	45
30	69	47	72	47	74	45	98	64	82	54	79	62
JULY 1	70	48	76	46	79	46	102	65	77	54	78	48
2	76	50	81	47	82	56	80	64	90	54	64	44
3	84	41	68	56	82	49	66	50	83	63	76	40
4	81	42	81	52	84	49	70	47	76	54	70	55
5	81	45	88	48	86	45	75	38	82	58	77	50
6	85	46	87	58	77	49	78	55	87	46	84	52
7	68	56	80	61	82	40	75	56	85	60	73	60
8	69	57	77	49	88	59	80	50	97	66	82	56
9	67	61	73	58	80	64	69	52	84	68	81	63
10	73	55	83	50	64	55	82	55	74	62	79	49
11	86	49	84	63	74	43	89	57	69	55	85	47
12	76	56	84	58	63	53	88	53	81	51	87	52
13	68	56	85	60	70	42	80	64	80	51	87	62
14	73	49	86	59	78	42	80	59	77	59	80	57
15	77	50	91	58	83	42	85	62	79	58	83	44
16	72	57	69	60	85	52	90	57	89	53	85	47
17	65	51	73	50	81	61	69	52	88	63	88	58
18	73	49	79	42	81	55	79	45	85	65	71	58
19	78	42	84	49	85	57	73	46	78	50	74	50
20	84	53	84	65	90	58	77	40	68	59	77	40
21	90	59	78	51	87	61	63	46	74	52	84	48
22	81	67	67	54	75	58	70	56	76	59	86	52
23	90	53	77	53	81	46	79	57	78	59	81	58
24	67	59	74	43	73	59	79	57	84	52	87	46
25	77	55	59	55	79	53	83	49	78	61	86	65

TABLE III (*Continued*)

MAXIMUM AND MINIMUM TEMPERATURES, DOUGLAS LAKE, MICHIGAN
(Degrees Fahrenheit)

	1924		1925		1926		1927		1928		1929	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
JULY 26	75	49	82	47	81	44	85	58	76	50	89	61
27	86	50	63	53	85	41	81	55	67	59	95	61
28	81	58	70	51	85	53	87	61	72	56	83	65
29	91	59	70	48	85	51	75	55	71	47	86	63
30	73	62	67	40	91	56	78	43	79	43	84	49
31	70	51	72	42	85	60	81	46	79	53	81	58
AUG. 1	69	52	74	52	87	66	59	51	78	56	72	42
2	73	42	83	51	90	62	73	36	79	61	82	44
3	81	57	87	58	85	57	79	46	78	62	66	57
4	82	60	87	52	65	60	71	53	68	64	65	54
5	85	55	85	50	68	58	73	49	78	61	71	52
6	74	64	86	51	76	61	86	49	79	57	74	43
7	78	56	86	60	76	58	78	59	87	58	78	45
8	74	59	78	58	77	47	73	49	89	58	79	45
9	71	53	86	58	81	50	73	38	91	58	84	55
10	73	45	78	56	75	58	81	42	82	62	81	61
11	69	54	77	53	75	56	80	48	72	53	72	60
12	72	48	80	49	70	58	79	44	80	46	79	49
13	67	50	81	57	78	62	84	48	84	46	72	51
14	73	40	83	58	82	58	76	53	86	50	62	51
15	67	54	86	49	84	44	70	50	89	53	62	50
16	65	53	91	53	81	59	72	44	—	55	65	40
17	63	51	95	56	69	55	73	43	—	—	75	52
18	72	49	89	65	75	45	63	49	88	53	70	54
19	66	44	82	58	66	57	74	46	..	54	75	44
20	65	56	..	..	71	58	75	39	..	..	71	39
21	73	47	..	..	65	55	..	39	..	..	80	49
22	73	64	..	..	74	56	..	..	..	..	85	59
23	73	53	..	..	79	57	..	..	..	..	82	58
24	75	—	..	..	76	53	..	..	..	..	85	49
25	76	46	..	..	76	46	..	..	..	..	85	53
26	78	51	..	..	76	54	..	..	..	..	71	59
27	72	62	..	..	82	51	..	..	..	..	68	54
28	74	52	..	..	90	57	..	..	..	..	69	54
29	84	54	..	..	..	58	..	..	..	..	71	53
30	89	57	..	..	..	..	..	..	..	..	81	40
31	76	58	..	..	..	..	..	..	..	..	87	55

TABLE IV

PRECIPITATION IN INCHES, DOUGLAS LAKE, MICHIGAN

	1924	1925	1926	1927	1928	1929
JUNE 10	....	tr	....	....	....	....
11	—	0.05	....	....	....	....
12	—	0.86	....	....	....	....
13	—	0.48	....	....	....	....
14	—	—	....	....	....	....
15	0.95	0.85	....	....	—	....
16	—	—	—	....	—	—
17	—	0.41	0.55	....	—	—
18	—	—	—	....	—	—
19	—	0.30	—	....	—	0.49
20	—	—	—	....	0.34	0.20
21	—	tr	0.08	....	—	—
22	—	0.08	0.13	....	0.01	0.73
23	tr	—	—	....	1.48	0.01
24	—	—	0.07	0.03	0.01	—
25	—	—	tr	—	0.53	—
26	—	0.08	tr	—	—	tr
27	0.33	0.15	—	—	0.46	0.93
28	0.32	0.14	0.01	—	0.46	0.03
29	0.08	—	—	—	0.35	tr
30	0.01	—	—	—	—	0.27
JULY 1	0.02	tr	—	tr	0.01	tr
2	tr	—	—	—	tr	—
3	—	0.30	—	—	0.33	—
4	—	tr	—	tr	tr	0.74
5	—	—	—	0.55	—	tr
6	tr	0.49	—	0.25	tr	0.14
7	0.62	—	—	—	—	0.76
8	0.01	—	—	—	0.48	—
9	0.70	0.11	0.73	0.03	0.02	0.01
10	—	—	0.01	—	0.01	—
11	—	0.60	—	0.05	—	—
12	0.22	—	0.45	0.02	—	—
13	—	—	—	0.64	—	tr
14	—	tr	—	—	0.56	—
15	0.08	0.55	—	—	—	—
16	0.87	tr	0.01	—	—	0.10
17	—	—	0.11	0.76	0.75	0.02
18	—	—	—	—	0.32	—
19	—	—	0.14	—	0.26	—

TABLE IV (*Continued*)

	1924	1925	1926	1927	1928	1930
JULY 20	—	0.02	0.02	—	0.18	—
21	—	—	0.68	0.25	tr	—
22	tr	—	—	0.15	—	0.04
23	—	—	—	—	—	tr
24	0.71	0.06	0.25	—	—	tr
25	—	0.67	—	—	—	—
26	0.01	—	—	0.01	0.25	—
27	—	0.19	—	—	0.08	—
28	—	—	—	tr	—	0.66
29	0.36	—	—	—	—	—
30	0.27	—	—	—	—	—
31	—	—	tr	—	tr	tr
AUG. 1	—	—	—	0.04	—	—
2	—	—	—	—	0.29	—
3	tr	—	—	—	1.77	0.25
4	—	—	0.21	0.11	0.18	—
5	—	0.06	0.04	—	—	—
6	0.35	—	0.02	tr	—	—
7	—	tr	—	—	—	—
8	0.21	—	—	—	—	0.01
9	—	tr	0.08	—	—	0.43
10	0.10	0.06	0.16	—	tr	0.58
11	0.14	—	0.02	—	—	—
12	tr	—	0.01	—	—	0.02
13	—	0.01	—	—	—	1.15
14	—	—	—	—	—	0.02
15	1.09	—	—	—	—	tr
16	0.68	—	0.05	—	—	—
17	—	—	—	—	—	0.06
18	—	tr	—	—	—	—
19	0.31	—	0.02	—	—	—
20	tr	....	—	—	....	—
21	—	....	1.24	—	....	—
22	1.45	....	0.01	....	....	—
23	—	....	—	....	....	—
24	—	....	—	....	....	—
25	—	....	—	....	....	—
26	0.14	....	0.27	....	....	—
27	—	....	—	....	....	—
28	—	....	—	....	....	—
29	—	....	—	....	....	tr
30	—	....	....	....	....	—
31	—	....	....	....	....	—

TABLE V

SOLAR MAXIMUM TEMPERATURES, DOUGLAS LAKE, MICHIGAN
(Degrees Fahrenheit)

		1926	1927	1928	1929			1926	1927	1928	1929
JUNE	15	...	...	135	...	JULY	24	114	125	143	154
	16	...	...	141	152		25	147	135	145	155
	17	...	...	148	...		26	146	139	145	156
	18	...	...	92	...		27	148	139	96	154
	19	...	...	138	95		28	145	147	137	148
	20	...	...	112	94		29	149	139	138	143
	21	...	...	137	...		30	154	144	145	149
	22	...	...	140	...		31	151	147	137	145
	23	...	...	126	...						
	24	...	124	132	...	AUG.	1	149	122	140	140
	25	...	124	58	...		2	147	137	128	146
	26	...	138	139	...		3	142	139	134	134
	27	...	143	138	91		4	83	124	68	135
	28	...	147	131	89		5	92	136	146	140
	29	...	147	119	...		6	128	142	156	147
	30	...	155	139	...		7	140	133	148	146
							8	156	132	150	144
JULY	1	...	159	124	...		9	151	137	151	151
	2	...	138	139	...		10	140	145	144	144
	3	...	124	142	...		11	141	142	140	137
	4	...	124	140	...		12	113	135	144	147
	5	...	133	139	...		13	136	143	147	120
	6	...	132	145	...		14	146	135	147	107
	7	...	135	121	...		15	146	140	148	—
	8	137	139	148	...		16	137	138	—	—
	9	107	106	144	...		17	146	142	—	135
	10	114	138	136	...		18	141	...	142	135
	11	138	145	127	...		19	103	...	...	149
	12	135	148	146	...		20	130	...	...	144
	13	143	140	145	...		21	101	...	...	141
	14	143	146	129	...		22	140	...	...	141
	15	143	148	146	...		23	139	...	...	149
	16	143	145	147	...		24	150	...	...	141
	17	144	131	151	...		25	142	...	...	140
	18	149	146	141	...		26	137	...	...	130
	19	137	136	140	...		27	145	...	...	139
	20	149	138	110	142		28	156	...	...	142
	21	150	95	121	149		29	...	...	...	138
	22	136	98	131	154		30	...	...	...	142
	23	147	133	141	150		31	...	...	...	143

SOME PROPERTIES OF INULIN IN RELATION TO ITS USES IN DIAGNOSTIC PROCEDURES

JAMES FYVIE AND GEORGE F. FORSTER

FERMENTATION of inulin is one of the "earmarks" of a pneumococcus, not perfectly dependable to be sure, but nevertheless relied upon to a considerable extent when used in conjunction with a bile solubility test and perhaps agglutination by type-specific sera.

Our primary purpose was not to study the usefulness of inulin in pneumococcus identification, but to employ inulin fermentation as a differential factor in the development of a plate culture method for distinguishing pneumococci from the green-producing streptococci. Some of the difficulties that we have encountered have been due to certain properties of inulin with which we had not been familiar and since these have a bearing upon its general usefulness in diagnostic procedure we have thought it worth while to describe them briefly.

Inulin is a polysaccharide derived from the roots of several species of the family Compositae, and particularly from the tubers of the dahlia. It differs from starch in some of its physical properties and in having levulose instead of dextrose as its monosaccharide base. It is almost completely precipitable by ethyl alcohol in concentrations greater than sixty per cent and this characteristic is chiefly made use of in its purification.

It hydrolyzes very readily to its monosaccharide base at 100° C. and this is, in fact, a commercial means for obtaining levulose. This also is the most important difficulty in its use in differential culture media, since both pneumococci and *Streptococcus viridans* ferment levulose (the three Avery types of pneumococci were used to verify this). In aqueous solution boiling for

just a moment produces sufficient monosaccharide to give a fairly strong Fehling's test and prolonged or repeated heating at lower temperatures gives a similar result. For example, an approximately twelve per cent solution of inulin had been heated on the water bath six or seven times to temperatures not over 80° C. in order to bring about solution. When this was tested with Fehling's solutions at 75° C. the red cuprous oxide precipitated after standing 20 or 30 minutes at room temperature. Of course, the degree of hydrolysis is greater when 15 lbs. pressure in the autoclave is used for sterilization, as is recommended by several of the most commonly used textbooks of bacteriology. The original source of the recommendation to sterilize in the autoclave seems to be Monograph No. 7 of the Rockefeller Institute on acute lobar pneumonia by Avery, Chickering, Cole and Dochez (1917), p. 20, and is based upon the presence of spores difficult to kill by other means.

One commercially prepared inulin of a high degree of purity gave no evidence of the presence of levulose as an impurity either by Fehling's test or by the osazone test. On the label, note is taken of the fact that if inulin is first added to the medium and then sterilized, even in the Arnold test, hydrolysis will occur. It is stated, however, that an aqueous solution can be autoclaved without hydrolysis and added to the medium. This has not been confirmed by our experience.

For use in culture media, therefore, we have employed solutions sterilized by filtration. But another problem is confronted here. Inulin is not very soluble in the cold and increasing concentrations require considerable increases in temperatures of solution, as shown in Chart I (Fig. 15). While 1 per cent inulin goes into solution in neutral distilled water at 49° C., 5 per cent requires 63° C.; 10 per cent, 65° C.; 15 per cent, 79.5° C.; and 20 per cent, 90° C. Carbohydrate solutions filtered by sterilization for use in differential media are commonly prepared in concentrated solution (most often 20 per cent) and are added to the media in small amounts. Fifteen per cent and 20 per cent solutions of inulin, however, appear to be in a zone where there is danger of splitting into simpler carbohydrates.

An interesting property of inulin is that, when it has been put

into solution by means of heat, it will not precipitate for some time after it has cooled to room temperature (if exception be made of solutions near 20 per cent concentration). Furthermore, the length of time required for precipitation varies inversely as the concentration. Chart 2 (Fig. 16) illustrates both these points. Twenty per cent inulin began to come down 15 minutes after being taken from the water bath with its temperature still at 60° C. Fifteen per cent inulin required 50 minutes and room temperature

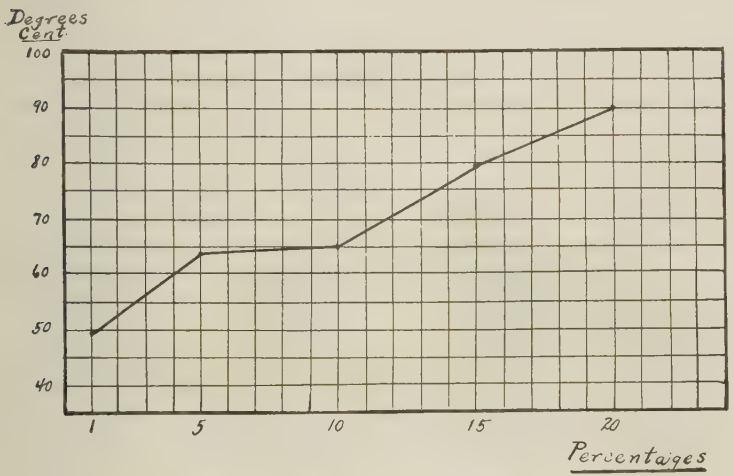

Fig. 15. Inulin solution temperatures

(23° C.) had been reached. The 10 per cent solution began to precipitate after 4 hours at room temperature, 5 per cent after 25 hours. One per cent inulin remains in solution at room temperature for several days, but in the refrigerator precipitates to some extent overnight.

All solutions were made up in test tubes with narrow necks drawn out in the flame and calibrated on the neck to hold 10 c. c. with a pipette certified to deliver 10 c. c. The distilled water was boiled and cooled to 20° C. immediately before use.

In view of these results we have adopted the following method for preparation of inulin-containing media:

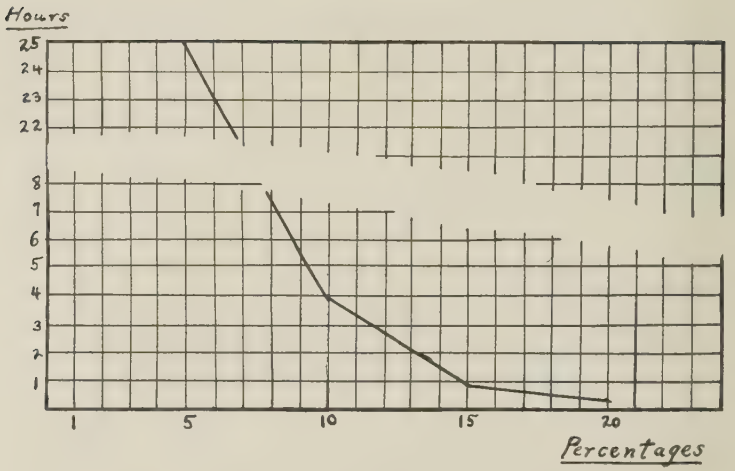

Fig. 16. Precipitation periods of inulin solutions

1. Grind the inulin in a mortar if it is not in the form of a fine powder.

2. Dissolve in 10 to 12 per cent concentration with a minimal amount of heat on the water bath.

3. Sterilize by filtration. We have used Seitz filters.

4. Add to the medium before inulin has begun to separate from solution, so as to avoid reheating.

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THE INFLUENCE OF PHOSPHATES ON THE METABOLISM OF BACTERIA

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EVER since 1886, when Hirschler (11) demonstrated that feeding large amounts of sugar inhibits the production of protein metabolic products in the intestines, the question of protein-sparing action, or the effect of carbohydrate fermentation on the accompanying protein decomposition, has been discussed at great length. Many theories of the relationship of carbohydrate to protein metabolism have been presented.

In the early work it was observed by Péré (15), Peckham (14), DeGraff (5), Rougentzoff (16), Kendal and coworkers (12), Sears (17), Glenn (8), Kligler (13) and Smith (19) that the presence of glucose or any other fermentable sugar prevented the formation of indol. When non-fermentable sugars were present, no inhibition of indol occurred. These workers arrived at the conclusion that sugar, being a more readily available source of energy than the amino acids, would be utilized by the organism first and later, when the sugar was completely destroyed, the amino acids would be used with the evolution of indol. This condition occurred, of course, only when calcium carbonate was added to neutralize the acid formed from the carbohydrate fermentation. If the acid was not neutralized, no indol was produced, as the organism would evolve an inhibitory amount of the acid even before complete utilization of the sugar occurred. Glenn (8) demonstrated that the acid formed in the carbohydrate fermentation inhibited indol production and gelatin liquefaction. In *Escherichia coli* fermentation the presence of 0.5 per cent lactic acid prevented indol formation.

All of the early and many of the later workers used the indol test as an index of the protein decomposition. It was inferred that the presence of indol was a qualitative test for protein and amino

acid decomposition. Thus, the absence of indol indicated that the organisms were obtaining their nitrogen supply from inorganic nitrogen compounds present. This reasoning is faulty, as pointed out by Distaso (6), who demonstrated that *Escherichia coli*, when grown in a medium containing glucose and tryptophane, produced indol. If, in addition, the medium contained asparagin, no indol was formed, since the organisms utilized the asparagin in preference to the trytophane. The writer concludes that, inasmuch as peptone contains many simple amino acids, these would be attacked before the tryptophane, hence the lack of indol in peptone-glucose water or other glucose media using peptone as a source of nitrogen. This being true, instead of a protein-sparing action as commonly believed, the usual protein fermentation occurs. Under all conditions the organism is splitting proteins and their by-products for its nitrogen supply, but where carbohydrates are available, the latter are used for energy rather than the amino acids, as would be the case in the absence of carbohydrates. The amount of protein decomposition would be less in the presence of carbohydrates unless a greater amount of growth could be induced before the metabolic products, particularly the acids from the carbohydrate fermentation, caused a cessation of growth. This view is confirmed by experiments in which the protein decomposition has been measured by the amino nitrogen and the ammonia nitrogen rather than by the occurrence of indol.

The results obtained by Kendal and his coworkers (12), Henderson and Webster (10), Berman and Rettger (2), DeBord (4) and Slanetz and Rettger (18) prove this point.

If we assume that protein fermentation is normal in the presence of carbohydrates and that the cessation of growth is due to metabolic products, as evidenced by the incomplete utilization of the sugar present, greater utilization of both the proteins and carbohydrates could be induced by elimination of these metabolic products. Glenn (8) has demonstrated that acids inhibit indol production. The elimination of the acid ought to allow increased growth of the bacteria. Péré (15) added calcium carbonate to the medium to neutralize the acid, but was unable to demonstrate indol, although no acid was present. He explained this by the

fact that the acidity probably fluctuated, since the insoluble calcium carbonate is slow in neutralizing the acid. Kligler (13) found that increased amounts of peptone caused greater ammonia production in the presence of fermentable carbohydrates. He attributed this to the buffer action of the peptone. He also used phosphates as buffers and demonstrated greater nitrogen metabolism. Berman and Rettger (2) and Slanetz and Rettger (18), DeBord (4) and Bronfenbrenner and Schlesinger (3) confirmed his findings.

Before an extensive cultural study of the paratyphoid group was made, it was deemed urgent that the best medium be selected to obtain the maximum growth. Accordingly, various media recommended for such work were studied. One per cent glucose was added to each of the following media: beef extract broth, peptone water, serum water and beef liver infusion broth. These broths were adjusted to pH 7. A twenty-four-hour broth culture of *Escherichia coli* was used for inoculation. The cultures were incubated at 37° C. for forty-eight hours. At the end of twenty-four and forty-eight hours' incubation, the broths were tested for sugar content, pH and titratable acidity. The glucose was determined by Benedict's method (1). The pH was determined electrometrically by the use of a quin-hydrone electrode. The results are presented in Table I. It will be observed that little

TABLE I

Comparison of Various Broth Media for Glucose Fermentation Determination with *Escherichia coli*

Determination	Hour	Extract	Beef infusion	Peptone water	Serum water	Liver infusion
Sugar.....	24	0.784	0.704	0.681	0.770	0.910
	48	0.702	0.667	0.667	0.720	0.877
pH.....	24	5.0	6.18	4.66	5.0	5.17
	48	4.49	4.83	4.32	5.33	5.17
Titre.....	24	1.0	2.0	3.5	0.5	5.5
	48	1.0	3.0	1.0	0.5	3.0

choice was evident among the media tested. Sugar utilization was slightly greater in the beef infusion and peptone water media. As a result of this study, the use of liver infusion broth and serum water media was discontinued.

In the second series of studies, comparisons of beef extract, beef infusion and peptone water broths with the same media, to which had been added 0.5 and 1 per cent mixtures of NaH_2PO_4 and K_2HPO_4, prepared as recommended by Slanetz and Rettger (18), were made. In one series of the media, containing 1 per cent mixture of phosphate buffer and the 0.5 per cent series, the phosphates were added during the preparation of the media before adjusting the pH to neutrality and filtering, so that a considerable amount of the phosphate was probably lost through precipitation and filtration. This procedure was used to determine the value of phosphate when added under these conditions. In the second 1 per cent series, the sterile solution of the salts having a pH of 6.8 was added to the sterilized media in amounts sufficient to give a 1 per cent concentration, as recommended by Slanetz and Rettger (18).

The following cultures were used: *Escherichia coli*, *Staphylococcus aureus*, *Shigella dysenteriae*, *Pasteurella boviseptica*, *Pseudomonas aeruginosa; Salmonella pullorum*, *sanguinarium*, *schottmülleri* and *paratyphi; Brucella suis*, *melitensis* and *abortus; Bacillus megaterium* and *subtilis*.

The media were inoculated with twenty-four-hour suspensions of each organism. The tubes were incubated at 37° C. Observations and tests were made at one, two and seven days. Tests were made for total sugar content, pH, titratable acidity and turbidity. Turbidity was determined by means of the Gates nephelometer (7). For brevity the organisms may be discussed as three groups: (1) aërogenic acid producers, (2) anaërogenic acid producers and (3) anaërogenic non-acid producers.

GROUP I

The aërogenic acid producers are represented by *Escherichia coli* and *Salmonella pullorum*. The data for the three media for *Escherichia coli* are presented in Tables II, III and IV. Irrespec-

TABLE II

ACTIVITY OF *Escherichia coli* IN GLUCOSE PEPTONE WATER AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Peptone water	Initial	0	6.8	0.38	1.0
	1	23	4.8	1.14	0.95
	2	15	4.8	1.14	0.77
	7	19	5.0	1.62	0.56
Peptone water with 1 per cent phosphate buffer (heated)	Initial	0	6.8	1.43	1.0
	1	18	5.2	4.02	0.59
	2	12	5.2	4.2	0.53
	7	10	5.2	4.57	0.45
Peptone water with 1 per cent phosphate buffer (unheated)	Initial	0	6.8	1.43	1.0
	1	20	5.0	3.1	0.5
	2	11	5.0	4.02	0.44
	7	12	5.2	4.47	0.37
Peptone water with 0.5 per cent phosphate buffer (heated)	Initial	0	6.8	1.43	1.0
	1	14	5.0	3.1	0.714
	2	11	5.2	2.85	0.53
	7	12	5.4	3.34	0.53

TABLE III

ACTIVITY OF *Escherichia coli* IN GLUCOSE BEEF EXTRACT BROTH AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Extract broth	Initial	0	7.2	0.19	1.0
	1	15	5.0	1.24	0.83
	2	14	5.2	2.85	0.67
	7	10	4.8	2.76	0.63
Extract broth with 1 per cent phosphate buffer (heated)	Initial	0	6.7	1.24	1.0
	1	12	5.2	5.43	0.45
	2	10	5.4	4.56	0.44
	7	10	5.0	5.09	0.5
Extract broth with 1 per cent phosphate buffer (unheated)	Initial	0	6.9	1.64	1.0
	1	13	5.6	6.02	0.37
	2	11	5.2	6.19	0.19+
	7	9	5.8	5.53	0.12+
Extract broth with 0.5 per cent phosphate buffer (heated)	Initial	0	6.8	0.96	1.0
	1	14	5.2	4.26	0.42
	2	10	5.6	5.53	0.42
	7	9	5.2	4.67	0.38

TABLE IV

ACTIVITY OF *Escherichia coli* IN GLUCOSE BEEF INFUSION BROTH AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Infusion	Initial	0	6.9	0.385	1.0
	1	14	5.0	1.62	0.77
	2	14	5.0	2.0	0.63
	7	9	5.4	2.38	0.59
Infusion with 1 per cent phosphate buffer (heated)	Initial	0	6.9	1.43	1.0
	1	10	5.2	4.95	0.48
	2	10	5.2	4.95	0.33
	7	8	5.4	5.9	0.35
Infusion with 1 per cent phosphate (unheated)	Initial	0	7.2	1.64	1.0
	1	9	5.4	5.9	0.17
	2	11	5.6	4.95	0.17
	7	8	6.0	4.28	0.2+
Infusion with 0.5 per cent phosphate buffer (heated)	Initial	0	7.2	1.24	1.0
	1	11	5.0	4.45	0.38
	2	10	5.2	4.75	0.35
	7	8	5.2	5.05	0.30

tive of the medium used, all flasks containing phosphates showed larger amounts of sugar utilization than the control. The flasks containing the unheated 1 per cent mixture of phosphate gave in all instances greater sugar utilization than the heated phosphate media. There were practically no differences between the 0.5 and 1 per cent mixtures of phosphate that were heated. Apparently the process of preparation removes all excess phosphate to the same extent, thus making the two mixtures practically identical in phosphate content.

The titratable acidity was two to three times higher in the phosphate media than in the corresponding controls. The increased acidity in the phosphate media is roughly a direct index of sugar utilization. One per cent phosphate broth produced larger amounts of acid than the 0.5 per cent phosphate medium.

Hydrogen ion concentrations demonstrated very little difference among the plain broths and the phosphate media. The controls, however, gave increased hydrogen ion concentrations, as would be expected in a medium lacking buffer.

Turbidity readings showed that greater growth resulted in the phosphate media than in the corresponding controls. The 1 per cent phosphate media gave slightly greater growth than the 0.5 per cent phosphate broth.

Durham fermentation tube tests of the various media showed more pronounced gas production in the phosphate broths than in the controls. The 0.5 per cent phosphate broth was slightly better than the 1 per cent phosphate medium.

The more complex the medium, in the sense that more available forms of nutrient were added, the less the influence of the phosphate on the amount of growth obtained. For example, the amount of growth produced in a phosphate beef infusion broth was considerably greater than in the phosphate peptone medium. Further, the difference in growth between peptone broth as compared with phosphate peptone broth was far greater than the difference between beef infusion broth and phosphate beef infusion broth. In all cases, however, the phosphate medium as compared with the same medium without the phosphate gave distinctly greater growth of organism.

TABLE V

ACTIVITY OF *Salmonella pullorum* IN GLUCOSE PEPTONE WATER AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Day of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Peptone water *	1	60	5.6	1.62	0.77
	2	40	5.0	0.95	0.67
	7	30	5.4	1.43	0.71
Peptone water with 1 per cent phosphate buffer (heated)	1	30	6.4	0.48	0.67
	2	20	5.6	3.52	0.44
	7	17	6.6	1.43	0.2 ††
Peptone water with 1 per cent phosphate buffer (unheated)	1	22	6.8	2.37	0.67
	2	17	5.4	3.84	0.45
	7	15	5.2	4.75	0.36
Peptone water with 0.5 per cent phosphate buffer (heated)	1	70	6.0	0.67	0.77
	2	45	5.0	0.76	0.71
	7	22	5.2	1.62	0.71

* Initial readings in Table II. † Contamination.

The data obtained with *Salmonella pullorum* are very similar to those from *Escherichia coli*. Only the data on peptone water medium (Table V) are presented. Owing to the fact that this organism is more exacting in growing conditions, greater activity is exhibited in the richer media.

GROUP II

The anaërogenic acid-producing bacteria are represented by *Staphylococcus aureus*, *Shigella dysenteriae* and *Pasteurella boviseptica*. The influence of phosphate on the three media with *Staphylococcus aureus* is presented in Tables VI, VII and VIII. Only

TABLE VI

ACTIVITY OF *Staphylococcus aureus* IN GLUCOSE PEPTONE WATER AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Peptone water *	1	38	5.8	0.76	0.91
	2	30	4.8	0.48	0.71
	7	15	5.0	0.95	0.71
Peptone water with 1 per cent phosphate buffer (heated)	1	20	6.4	2.37	0.83
	2	15	5.4	3.52	0.67
	7	10	5.4	4.39	0.56
Peptone water with 1 per cent phosphate buffer (unheated)	1	21	6.6	2.28	0.77
	2	14	5.8	3.16	....
	7	11	5.6	3.84	0.27
Peptone water with 0.5 per cent phosphate buffer (heated)	1	17	6.6	1.43	0.77
	2	12	5.2	2.37	0.67
	7	12	5.4	2.58	0.5

* Initial readings in Table II.

the results obtained with peptone broth, Tables IX and X, on *Shigella dysenteriae* and *Pasteurella boviseptica* are presented, since the data with the other media simulate the data obtained with *Staphylococcus aureus*. The data on peptone show the degree of variations obtained. The sugar utilization of these organisms was similar to that obtained with the aërogenic organisms. The unheated 1 per

TABLE VII

ACTIVITY OF *Staphylococcus aureus* IN GLUCOSE BEEF EXTRACT BROTH AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Extract broth *.....	1	17	5.4	0.76	0.77
	2	16	5.0	1.43	0.67
	7	15	4.8	1.43	0.77
Extract broth with 1 per cent phosphate buffer (heated).....	1	15	6.0	3.1	0.67
	2	13	5.2	5.39	0.53
	7	11	5.4	5.24	0.53
Extract broth with 1 per cent phosphate buffer (unheated)...	1	13	5.8	3.16	0.63
	2	10	5.8	4.95	...
	7	10	5.6	7.04	0.27
Extract broth with 0.5 per cent phosphate buffer (heated).....	1	15	6.0	2.37	0.71
	2	12	5.4	3.1	0.53
	7	15	5.5	4.2	0.45

* Initial readings in Table III.

TABLE VIII

ACTIVITY OF *Staphylococcus aureus* IN GLUCOSE INFUSION BROTH AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Infusion broth *.....	1	12	5.4	1.43	0.71
	2	9	5.0	3.33	0.67
	7	9	5.4	2.48	0.59
Infusion broth with 1 per cent phosphate buffer (heated).....	1	13	5.6	3.62	0.63
	2	10	5.4	4.56	0.45
	7	8	5.4	5.54	0.42
Infusion broth with 1 per cent phosphate buffer (unheated)...	1	14	6.0	3.84	0.63
	2	10	5.6	5.42	0.40
	7	10	5.6	6.68	0.24
Infusion broth with 0.5 per cent phosphate buffer (heated).....	1	11	5.8	4.1	0.63
	2	12	5.2	4.1	0.48
	7	9	5.0	5.84	0.40

* Initial readings in Table IV.

TABLE IX

ACTIVITY OF *Shigella dysenteriae* IN GLUCOSE PEPTONE WATER AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Peptone water *	1	75	5.6	0.38	0.91
	2	48	5.2	0.57	0.77
	7	23	5.0	0.48	0.83
Peptone water with 1 per cent phosphate buffer (heated).....	1	18	5.2	0.38	0.67
	2	15	5.4	3.42	0.67
	7	15	5.4	3.9	0.71
Peptone water with 1 per cent phosphate buffer (unheated)...	1	14	5.0	3.72	0.59
	2	13	5.4	3.52	0.53
	7	14	5.4	2.48	0.53
Peptone water with 0.5 per cent phosphate buffer (heated).....	1	15	5.2	2.19	0.63
	2	14	5.2	2.19	0.59
	7	14	5.0	2.48	0.67

* Initial readings in Table II.

TABLE X

ACTIVITY OF *Pasturella boviseptica* IN GLUCOSE PEPTONE WATER AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Peptone water *	1	40	6.3	1.22	0.77
	2	25	6.5	1.14	0.77
	7	..	5.4	....	....
Peptone water with 1 per cent phosphate buffer (heated).....	1	45	6.3	2.37	0.77
	2	38	6.6	1.52	0.77
	7	9	6.4	4.29	0.67
Peptone water with 1 per cent phosphate buffer (unheated)...	1	30	6.4	1.52	0.71
	2	28	6.3	2.19	0.71
	7	9	6.6	5.42	0.67
Peptone water with 0.5 per cent phosphate buffer (heated).....	1	35	6.4	1.52	0.71
	2	27	6.4	1.14	0.67
	7	10	5.4	2.66	0.59

* Initial readings in Table II.

cent phosphate broth caused greater sugar consumption than either the 0.5 or the 1 per cent heated phosphate broths. The latter two media were practically identical in the results obtained.

The pH readings were nearly constant except that the unbuffered media showed slightly lower hydrogen ion concentrations. The titratable acidity was two to three times greater in the phosphate media than in the controls. Turbidity readings indicated greater numbers of bacteria produced in the presence of the phosphates.

The spore-forming bacilli, namely, *Bacillus subtilis* and *Bacillus megaterium*, were also studied. These organisms, although producing acid in glucose, are also strong ammonifers. They were included to demonstrate the effect of phosphates on organisms of this type. The data obtained with *Bacillus megaterium* are presented in Tables XI-XIII. The results were in close agreement with those obtained with the other anaërogenic organisms examined.

To summarize, the data show on the anaërogenic organism that

TABLE XI

ACTIVITY OF *Bacillus megaterium* IN GLUCOSE PEPTONE WATER AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Peptone water *.....	1	26	5.2	0.76	0.91
	2	24	5.2	0.67	0.83
	7	11	5.4	1.15	0.71
Peptone water with 1 per cent phosphate buffer (heated).....	1	13	5.5	3.62	0.71
	2	13	5.4	3.65	0.67
	7	12	5.5	4.8	0.56
Peptone water with 1 per cent phosphate buffer (unheated)...	1	12	5.6	3.84	0.67
	2	13	5.4	4.03	0.53
	7	9	5.4	4.7	0.34
Peptone water with 0.5 per cent phosphate buffer (heated).....	1	15	5.4	2.48	0.77
	2	11	5.2	2.11	0.67
	7	9	5.2	2.97	0.52

* Initial readings in Table II.

TABLE XII

ACTIVITY OF *Bacillus megaterium* IN GLUCOSE BEEF EXTRACT BROTH AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Extract broth *.....	1	18	5.4	0.95	1.0
	2	16	5.2	0.96	0.83
	7	11	5.2	1.53	0.71
Extract broth with 1 per cent phosphate buffer (heated).....	1	16	5.8	6.29	0.33
	2	14	5.6	6.04	0.33
	7	9	5.6	6.91	0.22
Extract broth with 1 per cent phosphate buffer (unheated)...	1	11	5.6	4.0	0.77
	2	10	5.8	4.12	0.67
	7	10	5.6	5.76	0.48
Extract broth with 0.5 per cent phosphate buffer (heated).....	1	12	5.4	3.84	0.67
	2	10	5.8	3.84	0.59
	7	11	5.6	6.23	0.42

* Initial readings in Table III.

TABLE XIII

ACTIVITY OF *Bacillus megaterium* IN GLUCOSE INFUSION BROTH AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Infusion broth *.....	1	11	5.5	1.62	0.91
	2	11	5.6	1.92	0.67
	7	8	5.4	1.25	0.38
Infusion broth with 1 per cent phosphate buffer (heated).....	1	11	5.2	4.47	0.67
	2	10	5.8	4.61	0.63
	7	10	5.6	4.8	0.42
Infusion broth with 1 per cent phosphate buffer (unheated)...	1	15	6.0	5.7	0.33 (?)
	2	18 scum	6.0	5.46	0.33
	7	8	5.8	4.31	0.11 (?)
Infusion broth with 0.5 per cent phosphate buffer (heated).....	1	15	5.2	4.29	(?)
	2	11	5.8	4.22	0.56
	7	8	5.4	4.8	0.20

* Initial readings in Table IV.

the presence of phosphate in all instances enhanced growth and metabolism, as evidenced by all the tests conducted.

GROUP III

The anaërogenic non-acid-producing bacteria are represented by *Brucella suis* and *Pseudomonas aeruginosa*. The results for *Brucella suis* are presented in Tables XIV, XV and XVI. The data for peptone water medium for *Pseudomonas aeruginosa* are presented in Table XVII. These two organisms were selected since they are generally supposed to have no action on glucose. The data obtained show, however, that the particular strain of *Pseudomonas aeruginosa* tested fermented glucose to nearly the same degree as *Escherichia coli* even in the absence of phosphates, but the titratable acidity and pH are far less than those obtained with *Escherichia coli*. After forty-eight hours' incubation the utilization of sugar is quite high, with a correspondingly high titratable acidity in the presence of phosphates. The pH is practically the same as the initial pH, again showing the effect of the

TABLE XIV

ACTIVITY OF *Brucella suis* IN PEPTONE WATER AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Peptone water *.....	1	80	6.5	0.29	1.0
	2	50	6.0	0.48	0.91
	7	12	6.5	0.48	0.91
Peptone water with 1 per cent phosphate buffer (heated).....	1	92	6.6	1.8	1.0
	2	65	6.5	1.90	0.83
	7	11	5.8	3.42	0.71
Peptone water with 1 per cent phosphate buffer (unheated)...	1	28	6.6	1.52	0.83
	2	22	6.6	1.62	0.83
	7	10	6.6	2.86	0.83
Peptone water with 0.5 per cent phosphate buffer (heated).....	1	25	6.3	0.95	0.83
	2	22	6.5	0.95	0.83
	7	11	5.8	1.22	0.77

* Initial readings in Table II.

TABLE XV

ACTIVITY OF *Brucella suis* IN GLUCOSE BEEF EXTRACT BROTH AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Extract broth *.....	1	clear	7.7	0.48	1.0
	2	70	7.5	0.95	0.83
	7	11	5.4	1.14	0.83
Extract broth with 1 per cent phosphate buffer (heated).....	1	clear	6.4	1.91	0.91
	2	65	6.4	1.62	0.83
	7	8	5.2	5.24	No growth
Extract broth with 1 per cent phosphate buffer (unheated)...	1	31	6.6	1.91	1.0
	2	25	6.5	2.19	0.71
	7	8	5.4	7.04	No growth
Extract broth with 0.5 per cent phosphate buffer (heated).....	1	25	6.6	0.76	1.0
	2	25	6.5	1.52	0.83
	7	10	6.0	3.72	0.67

* Initial readings in Table III.

TABLE XVI

ACTIVITY OF *Brucella suis* IN GLUCOSE INFUSION BROTH AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Infusion broth *.....	1	73	6.5	0.95	1.0
	2	48	6.2	0.57	0.83
	7	10	5.9	2.20	0.77
Infusion broth with 1 per cent phosphate buffer (heated).....	1	90	6.3	2.09	1.0
	2	65	6.1	1.78	0.83
	7	8	6.0	4.56	0.71
Infusion broth with 1 per cent phosphate buffer (unheated)...	1	sl. †	6.4	2.28	1.0
	2	72	6.6	2.48	0.83
	7	7	5.8	6.95	No growth
Infusion broth with 0.5 per cent phosphate buffer (heated).....	1	sl. †	6.6	1.02	1.0
	2	42	6.6	1.90	....
	7	7	5.4	6.29	0.48

* Initial reading in Table IV.

† Slightly turbid.

TABLE XVII

ACTIVITY OF *Pseudomonas aeruginosa* IN GLUCOSE PEPTONE WATER AS COMPARED WITH THE SAME MEDIUM CONTAINING PHOSPHATE SALT BUFFER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Peptone water *.....	1	24	5.4	0.48	0.67
	2	20	5.2	0.95	0.67
	7	9	5.0	1.14	0.77
Peptone water with 1 per cent phosphate buffer (heated).....	1	30	6.3	1.4	0.77
	2	15	5.1	1.62	0.67
	7	10	6.4	1.8	0.63
Peptone water with 1 per cent phosphate buffer (unheated)...	1	28	6.5	1.43	0.67
	2	15	6.6	1.8	0.59
	7 †	..	6.5	1.32	....
Peptone water with 0.5 per cent phosphate buffer (heated).....	1	18	6.4	1.22	0.77
	2	11	6.4	0.95	0.37
	7 †	..	6.4	1.8	....

* Initial readings in Table II. † Slime formation prevented measurements.

phosphate buffer. The turbidity readings are markedly in favor of the phosphates, which demonstrates the increased growth occurring in the presence of the phosphates. The growth obtained in the phosphate media was quite different from that obtained in the controls, being characterized by decided slime formation. The writers have never observed this action on any strain of this organism studied under the usual cultural conditions.

Contrary to the general conception, the culture of *Brucella suis* also utilized glucose. Greater amounts were used with the phosphate media than in the controls. The titratable acidity was slight in the controls, but marked in the phosphate media. The pH readings varied slightly, but no significant differences were noted. Decidedly greater numbers of cells were produced in all phosphate media, as evidenced by the turbidity readings. Cultures of *Brucella melitensis* and *Brucella abortus* gave practically the same results as *Brucella suis*.

The value of phosphate media for the growth of these organisms was clearly demonstrated.

Although it is generally accepted that phosphate may cause greater growth because of strong buffering action, no definite research has been done to prove it. The data obtained indicated, in many respects, other activity of the phosphate than that of buffer. If another type of buffer would give results comparable to those from phosphate, it was felt that the action must be purely buffer action. Unfortunately there are no buffers available that cover the same pH range as phosphates that are not toxic for bacteria. After testing many combinations, we found that a 2 per cent solution of sodium citrate not only simulated the phos-

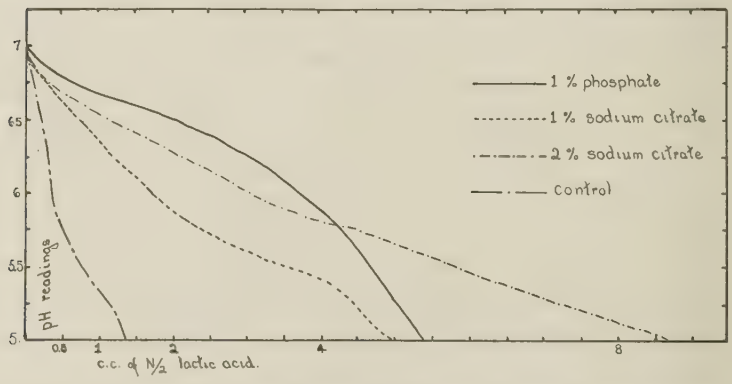

FIG. 17. Effect of various buffers on pH changes in plain peptone water

phate curve (Fig. 17), but in the lower range around pH 5.5 actually was much better. With *Salmonella pullorum*, the inhibitory acid content is approximately pH 5, so that any lessening of the approach to pH 5 should give a correspondingly greater growth of this organism. Media containing unheated buffers of 2 per cent and 1 per cent sodium citrate were prepared. They were then tested with *Salmonella pullorum* as a test organism. Glucose peptone water and 1 per cent phosphate buffered peptone water were used as controls. The procedure was exactly the same as that used in previous experiments. The results are tabulated in Table XVIII. It will be observed that, although the 2 per cent sodium citrate medium was the better buffer solution, still the

TABLE XVIII

THE EFFECT OF DIFFERENT BUFFERS ON THE ACTIVITY OF *Salmonella pullorum* IN GLUCOSE PEPTONE WATER

Medium	Days of incubation	Turbidity	pH	Titratable acidity	Percentage of sugar
Peptone water	1	0	6.86	0.384	0.83
	2	48	4.83	0.384	0.71
	7	47	5.0	1.05	0.77
Peptone water with 2 per cent sodium citrate	1	0	7.2	0.48	0.71
	2	70	6.4	0.287	0.71
	7	33	5.0	3.74	0.44
Peptone water with 1 per cent sodium citrate	1	0	7.03	0.384	0.77
	2	55	5.0	0.192	0.66
	7	30	4.8	2.59	0.45
Peptone water with 1 per cent phosphate buffer	1	20	6.4	0.96	0.67
	2	33	5.9	2.2	0.56
	7	26	4.8	5.18	0.44

amount of growth and physiological activity was, in most cases, less than in the 1 per cent phosphate medium. The 1 per cent sodium citrate medium, although a much poorer buffer than either the 1 per cent phosphate or the 2 per cent sodium citrate media, gave results nearly equal to those of the 2 per cent sodium citrate medium.

These results are quite in accord with data presented by Winslow and Fabian (20) in their studies on antagonistic action of the sodium ion. They found that concentration of sodium in the range of 0.1 to 0.4 per cent gave maximum growth of *Escherichia coli*. The 2 per cent sodium citrate medium used in their experiments had a sodium content of 0.386 per cent. This would eliminate the sodium as the cause of the lessened growth in the 2 per cent sodium citrate medium.

The data obtained justify the conclusion that, although the increased growth is largely due to buffer action, still the phosphate radicle itself must be responsible for part of the activity. This assumption is based on the fact that the 2 per cent sodium citrate medium did not give increased growth over the 1 per cent phosphate, although it had greater buffering action. Further, the

growth in the 1 per cent sodium citrate medium was nearly equal to that in the 2 per cent, although its buffering action was far less marked. The fact that these two buffers, one inferior and the other superior to phosphate buffer, gave the same amount of growth indicates quite strongly that the phosphate radicle must have an added property other than buffer action.

In another set of tests the amount of phosphate in the various media was studied and its buffering action measured against the amount of activity evidenced in each medium. Chemical analyses

TABLE XIX

PHOSPHORUS CONTENT OF THE PEPTONE WATER AND THE SAME MEDIUM WITH ADDITION OF PHOSPHATE BUFFER

Medium	Grams of phosphorus 100 c.c. of medium	Percentage of phosphorus as compared with unheated buffer broth
Glucose peptone water	0.0005 gm.	0.246
Glucose peptone water with 1 per cent phosphate buffer (heated)	0.171 gm.	84.2
Glucose peptone water with 1 per cent phosphate buffer (unheated)	0.203	100.0
Glucose extract broth	0.002	0.985
Glucose extract broth with 1 per cent phosphate buffer (heated)	0.192	94.09
Glucose extract broth with 1 per cent phosphate buffer (unheated)	0.203	100.0
Glucose infusion broth	0.023	0.113
Glucose infusion broth with 1 per cent phosphate buffer (heated)	0.181	89.16
Glucose infusion broth with 1 per cent phosphate buffer (unheated)	0.203	100.00

for phosphates were made of the various media used. The results are tabulated in Table XIX. It will be noted that the unbuffered broths are very low in phosphorus content as compared with both the heated and unheated phosphate broths. In the peptone water, for example, the glucose peptone water contained only 0.0005 gm. of phosphorus per 100 c. c. of broth. This was only 0.246 per cent of the amount contained in the unheated 1 per cent phosphate broth. Similar results were obtained with the extract and beef infusion broths. The effect of the phosphate content on buffer

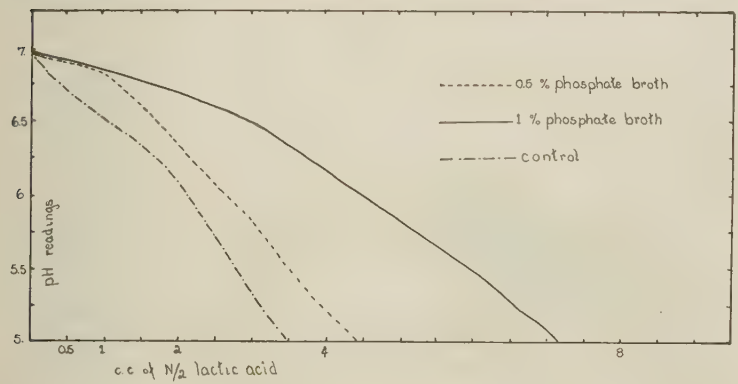

FIG. 18. Comparison of changes in pH in beef extract broth with and without phosphate buffer

action is presented graphically in Figures 18–20. The 0.5 per cent phosphate broth produced a curve falling between the 1 per cent phosphate medium and the control. In the case of the peptone water and extract broths, the 0.5 per cent buffer curve is nearer the control broth curve than is the 1 per cent phosphate. If the activity of the organism was dependent upon buffering effect of the medium, then the data should show a closer relationship between the unbuffered broth and the 0.5 per cent phosphate broth, but, on the contrary, the results obtained are very similar to those obtained in the 1 per cent phosphate. The extract broth showed a similar condition, as did the infusion broth, but to a lesser degree.

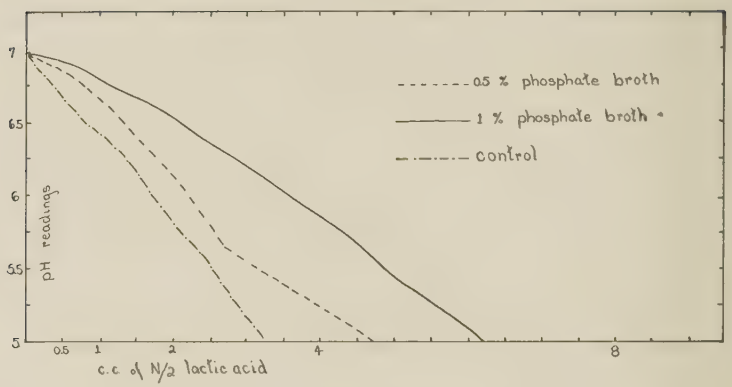

FIG. 19. Comparison of changes in pH in peptone water with and without phosphate buffer

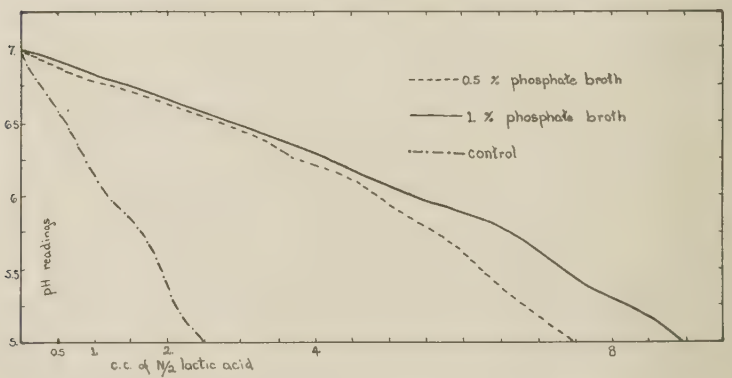

FIG. 20. Comparison of changes in pH in beef infusion broth with and without phosphate buffer

These data thus confirm the results obtained with different buffers and show that the addition of phosphate enhanced growth to a greater extent than the buffer alone. It may be concluded from them that phosphates play an important rôle in the metabolism of the organisms studied. As the organisms studied are of

TABLE XX

THE QUANTITY OF *Escherichia coli* OBTAINED BY GROWING ON GLUCOSE PEPTONE AGAR AS COMPARED WITH THE SAME MEDIUM CONTAINING VARIOUS BUFFERS

Medium	Turbidity in mm. of suspension
Glucose peptone agar	23 mm.
Glucose peptone with 1 per cent phosphate buffer (heated)	10 mm.
Glucose peptone agar with 1 per cent phosphate buffer (unheated)	10 mm.
Glucose peptone agar with 2 per cent sodium citrate (heated)	20 mm.
Glucose peptone agar with 2 per cent sodium citrate (unheated)	19 mm.

diverse types, it seems reasonable to expect many other bacteria to be likewise affected.

Inasmuch as the data presented apply only to liquid media, the use of buffers was tested in solid media. Cultures of *Escherichia coli* were grown in a glucose peptone agar alone and in the presence of 1 per cent phosphate buffer and 2 per cent sodium citrate buffer. Two Kolle flasks of each medium were used. Each flask was inoculated with 0.5 c.c. of a twenty-four-hour culture of *Escherichia coli* and incubated for forty-eight hours at 37° C. At this time the suspensions were carefully removed from each flask by washing with 10 c.c. of normal saline. After thorough shaking of the suspensions, 1 c.c. of each suspension was removed and diluted ten times and turbidity measurements

were made with a Gates nephelometer to ascertain the quantity of growth obtained. The data presented in Table XX demonstrate the same results, viz., that the addition of phosphates to the solid media increases the amount of growth materially. Further, the citrate buffer, although buffering in the same range as the phosphates, caused only slightly increased amounts of growth as compared with the controls.

DISCUSSION

The data presented in this paper demonstrate the significant rôle played by the mono- and di-potassium and sodium phosphate salts in the fermentation of carbohydrates. No attempt has been made to measure the protein activity of the organisms, since the writers feel that adequate knowledge on this point has already been presented by others. The purpose of this paper is not to study protein-sparing action, but to demonstrate that in the presence of phosphates greater bacterial activity is evidenced. More sugar is utilized and greater growth of the organisms is obtained. Inasmuch as the organisms tested represent various groups of bacteria, it seems that other organisms would behave in a similar manner. The addition of at least 0.5 per cent phosphate buffer to media would seem warranted.

The functions of phosphates seem to be buffer action and metabolic uses. It appears reasonable that an elimination of the active hydrogen ions would allow much greater activity on the part of the bacteria, since a longer period in their favorable growth zone would be possible.

The use of phosphates in the building of cell structure is well known in both animal and bacterial physiology. Guillemin and Larson (9) have demonstrated that 35.61 per cent of the dry weight of ash of *Escherichia coli* is $Ca_3(PO_4)_2$, of which 21.54 is P_2O_5. These figures were obtained by growing the organism in nutrient broth containing 0.2 per cent P_2O_5. In the glucose peptone water used in the experiments cited in this paper, phosphorus computed as P_2O_5 would amount to 0.002 per cent, one hundredth of the amount used by Guillemin and Larson. Such a medium is deficient in phosphates, for both buffer action and

nutritive purposes. During the process of preparing media the adjustment of reaction and the necessary sterilization precipitate a large amount of the naturally occurring phosphates, leaving the media poor in phosphorus. Under our present system this loss of salts is made up by replacement with sodium chloride. This adjusts for osmotic pressure, but does not compensate for the phosphates.

The best time to add the phosphates is after sterilization. A mixture of the primary and secondary salts serves to adjust the pH to the proper titre for the organism. Varying the proportions of the two salts allows a manipulation of the pH within the buffer range of the phosphates. Adding the salts after sterilization also prevents a loss through precipitation. In media in which the addition is inconvenient after sterilization, the adding before heating improves the medium materially, even though much of the phosphates is lost in the process of preparation.

CONCLUSION

The addition of primary and secondary sodium or potassium phosphate salts to ordinary nutrient media caused an increased physiological activity of the organisms examined.

Although the phosphate salts act as buffers and lessen for a time, at least, excessive activity and thus allow greater development of the organisms, the phosphate also plays a part in the direct metabolism of the organisms.

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A NOTE ON THE SPECIFICITY OF THE KAHN REACTION IN MENINGITIS

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DURING the 1929 epidemic of meningitis an opportunity was afforded to study the specificity of the Kahn reaction in this particular disease. Spinal fluids from a number of patients suffering from this malady were sent to the Michigan Department of Health for examination, which consisted of Pandy's test for globulin, colloidal gold curve, the Kahn reaction and general bacteriology. Of special interest was the fact that in an appreciable number of spinal fluids the Kahn test gave weakly positive reactions. Since we were unable to find in the literature a single report of a study concerning the specificity of a flocculation or a precipitation method in non-syphilitic meningitic patients, it seemed worth while to report our findings with the Kahn procedure. Before presenting our results, however, it might be well to mention some of the work which has been done in this connection with the Wassermann reaction.

Zadek (8) reported five cases of meningitis in which the Wassermann reaction of the blood was negative while that of the spinal fluid was positive. No evidence of syphilis was found upon postmortem examination.

Zange (9) cited reports of Kromfeld, Kraemers and others, each of whom mentions single cases which gave positive spinal fluid and negative blood reactions in which no clinical evidence of syphilitic infection was found, though there was definite evidence of epidemic or tuberculous meningitis.

Malcolm (6) reported eight atypical Wassermann reactions in a series of eight hundred and forty-eight spinal fluids. These eight reactions were positive with the acetone insoluble antigen of Bordet, but negative with the cholesterolized antigen of Kolmer, ex-

cept that one of these fluids, from a patient with a cerebral tumor, was positive with both antigens. Three of these fluids were from syphilitic patients, but the patient with the cerebral tumor which was positive with the Kolmer antigen was not syphilitic.

Schaffle and Riesenberg (7) reported eight cases which gave positive spinal fluid reactions with the complement fixation test and were definitely non-syphilitic. The blood sera from six of these patients were tested and found to be negative. A diagnosis of pulmonary tuberculosis was made in four cases, traumatic meningitis in one, and no diagnosis was made in three. The Kolmer modification of the Wassermann test was employed, with a slight change in technique, except in one instance. This one exception was carried out exactly according to the Kolmer method.

From these reports one is led to believe that an occasional false positive reaction does occur with spinal fluids from non-syphilitic meningitic patients when tested by means of the Wassermann reaction, although we must remember that Kolmer (3), one of our leading serologists, says that in his experience with spinal fluids from all types of non-syphilitic meningitis (pneumococcic, streptococcic, staphylococcic, meningococcic, tuberculous and influenzal) he has obtained no false positive reactions.

During the epidemic mentioned above the Kahn test for syphilis was made upon eighty-five spinal fluids from patients suffering from meningitis. In discussing these reactions a general consideration of the Kahn test will not be made, since many publications (1, 2, 5) are already available on this subject, although we might say that it has been shown (4) that the Kahn spinal fluid reaction is similar in sensitiveness and specificity to a well-controlled Wassermann test.

Results of twenty-six of the eighty-five spinal fluids which came from meningitic patients have been listed in the accompanying table for study because they gave some reaction with either the standard or presumptive procedure. It will be noted that in every case except one there was a definite increase in globulin, as shown by the Pandy reading. In every spinal fluid gram negative diplococci were found either on direct examination or on culture and in a few the type of the organism was determined. All except

TABLE I

Meningitic Cases Which Gave Some Reaction in the Kahn Test

Case No.	Pandy	Colloidal gold	Kahn reaction						Bacteriological findings		
			Standard			Presumptive			Gram negative diplococci		Type
			1	2	3	1	2	3	On direct examination	On culture	
374	++++	0000112211	−	−	0	−	+	+	found	found	I
444	++++	0000001122	−	−	±	−	±	±	do.	not found	....
470	++++	0000011210	−	±	0	+	+++	+++	do.	do.	....
509	++++	0000012322	−	−	0	−	±	±	do.	do.	....
516	++++	0000122100	−	−	+	−	++	++	not found	found	I
531	++++	0000123210	−	+	0	−	+	++	found	not found	....
568	++++	0001232110	−	−	0	−	+	+++	do.	do.	....
571	++++	0000011232	−	−	±	−	+++	++++	do.	do.	....
584	++++	0000001233	−	±	±	−	±	±	do.	found	I
646	+++	0000012210	++	++++	++++	++++	++++	++++	do.	not found	....
681	++++	0000011221	−	±	0	−	0	−	do.	do.	....
686	++++	0000001100	−	−	0	−	−	±	do.	found	....
786	++++	0000001100	−	−	0	−	−	±	do.	do.	I
804	++++	0011112332	−	−	−	−	±	+	do.	not found	....
833	++++	0001122332	−	±	±	−	±	±	do.	do.	....
834	++++	0000123321	−	0	±	−	0	0	do.	found	I
869	+++	0000011210	−	+	+	−	+	0	do.	do.	....
900	++++	0000011221	−	−	+	−	+	−	do.	do.	I
901	++++	0011111211	−	+	−	−	+	0	do.	not found	....
903	++++	0000012211	−	−	0	−	+	++	do.	found	I
961	++++	0000011234	−	−	+	−	−	±	do.	do.	I
993	++++	0000001211	−	0	±	−	0	0	do.	do.	I
1097	+++	0000001233	−	−	−	−	±	±	do.	do.	....
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1398	+++	0001112332	−	±	−	−	++++	0	do.	do.	....

numbers 516, 686 and 766 gave meningitic colloidal gold curves. When the standard Kahn antigen was employed only one spinal fluid gave a reaction sufficiently strong to be reported positive. Unfortunately, we were unable to determine whether or not this patient showed clinical manifestations of syphilis. On the other hand there were a few cases which gave positive reactions when the presumptive antigen was used.

Although it was impossible to obtain satisfactory clinical information relative to the patients from whom these spinal fluids were submitted, when the definite evidence of meningitis and the weak serological evidence of syphilis are considered, the following conclusions may be made.

CONCLUSIONS

1. The Kahn standard antigen gave one false positive reaction when employed in testing eighty-five spinal fluids from non-syphilitic meningitic patients; the presumptive antigen gave several non-specific positives. The spinal fluid giving the so-called false positive reaction was from a patient whose clinical history we were unable to obtain.

2. It seems reasonable to believe that a certain amount of reagin is formed in the spinal fluids of non-syphilitic meningitic patients analogous to the reagin which causes precipitation (or fixation) in meningitis caused by syphilis.

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